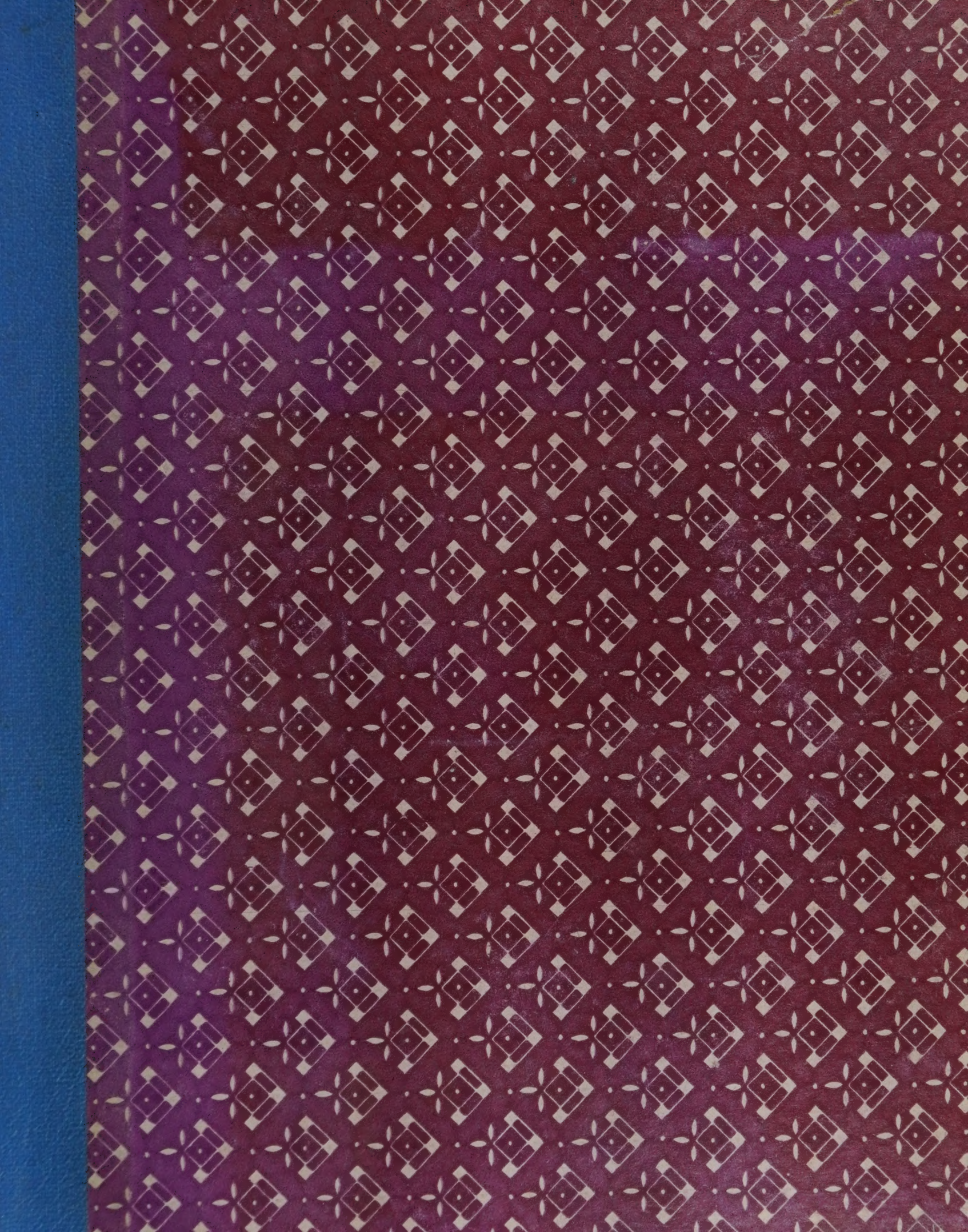




INTERNATIONAL FOOD INFORMATION SERVICE

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FAB 50

MYCOTOXINS IN FOODS (EXCLUDING AFLATOXINS & MICROBIAL TOXINS)

SELECTED FROM VOLUME **14**

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of:-

Commonwealth Agricultural Bureaux, Farnham Royal, Slough; Gesellschaft für Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

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Copies of all original articles referred to in the abstracts may be bought (or occasionally borrowed) from the International Food Information Service. A form for ordering these is provided at the end of this FAB.

Coverage of the subject has been restricted to that of Food Science and Technology Abstracts, which covers over 1200 of the important food journals, patents from 20 countries and books published world-wide. Every effort is made to include all significant references, but editorial discretion is used on the many articles of borderline interest. If the reader particularly needs an exhaustive search of the subject, we will be pleased to provide any other references that we have available. We would, in any case, encourage readers to write or telephone us with any comments or queries that they may have.

H. BROOKES

EDITOR

1

[Characteristics of mycoflora of barley and malts.]
Chelkowski, J.; Tobiasz, W.; Karwowska, W.
Przemysł Fermentacyjny i Owocowo-Warzywny 24
(12) 6-8 (1980) [6 ref. Pl, ru, en]

Combine-harvested grain is relatively prone to moulding; data from a 3-yr investigation of this behaviour are presented for barley. Moulds identified were *Aspergillus*, *Cephalosporium*, *Penicillium*, *Phycomycetes*, *Trichothecium*, *Botrytis*, *Chlamydomycetes*, and Fungi Imperfecti; ochratoxin A was detected, but no aflatoxin. It is recommended that clean sound grain should contain <5000 spores/g; at levels of 500 000 spores/g amounts of mycotoxins, especially ochratoxin can be appreciable. In 1979 there was a high mycotoxin-producing *Fusarium* activity. More attention should be given to these moulds and to their metabolites. STI

2

Mycotoxins in coffee.

Levi, C.

Journal of the Association of Official Analytical Chemists 63 (6) 1282-1285 (1980) [17 ref. En] [General Foods Corp., Tech. Cent., White Plains, New York 10625, USA]

This paper reviews several studies relating to the susceptibility of green coffee beans to contamination by mycotoxins. Aspects covered by the studies include: normal mould flora of coffee beans; mycotoxin production in beans inoculated with *Aspergillus* spp.; effect of coffee roasting on 3 mycotoxins (aflatoxin, ochratoxin, sterigmatocystin); and the presence of these 3 mycotoxins in commercial samples of green coffee. Some previously unpublished studies of the occurrence of these mycotoxins in green coffee are also briefly reported; the results obtained indicated that the frequency of contamination is extremely low and that, when mycotoxins are found, the level of contamination is also low. Because of these findings and the knowledge that 70-80% of any mycotoxin present is destroyed during roasting it is concluded that the probability of finding mycotoxins in coffee beverage is very low. The author therefore recommends that studies of mycotoxins in coffee be discontinued. JA

3

Distribution of T-2 toxin in wet-milled corn products.

Collins, G. J.; Rosen, J. D.

Journal of Food Science 46 (3) 877-879 (1981) [13 ref. En] [Dep. of Food Sci., Cook Coll., Rutgers Univ., New Brunswick, New Jersey 08903, USA]

The distribution of T-2 toxin in wet-milled corn products was studied by processing contaminated corn with bench scale wet-milling equipment. Approx. two-thirds of the T-2 toxin initially present was removed by the steep and process water, 4% was found in starch and the remainder was distributed between germ, gluten, and fibre. The toxin concn. in germ was 163-194% of the toxin concn. in the corn from which it was derived, while the T-2 toxin concn. in starch was 6.6-8.8% of the concn. in corn. The steep water concn. was related to the concn. of T-2 toxin in the original corn and the human consumption products. This may provide a convenient substrate for toxin assay. IFT

4

Seed mycoflora, its role in grain spoilage and production of mycotoxins.

Chenulu, V. V.; Dharam Vir

Bulletin of Grain Technology 17 (2) 148-157 (1979) [56 ref. En] [Div. of Mycology & Plant Path., Indian Agric. Res. Inst., New Delhi-110 012, India]

Aspects discussed include role of fungi; storage fungi, factors affecting spoilage of grains; seed mycoflora and nature of loss; and mycotoxins and other harmful effects of storage fungi and their control. CFTRI

5

The occurrence of ochratoxin A in mouldy bread and flour.

Osborne, B. J.

Food and Cosmetics Toxicology 18 (6) 615-617 (1980) [18 ref. En] [Flour Milling & Baking Res. Ass., Chorleywood, Rickmansworth, Herts. WD3 5SH, UK]

Mouldy bread (13 samples from the domestic environment, 6 samples from retail stores and 31 samples from commercial bakeries) and 7 samples of mouldy flour lumps sieved from bulk silo flour at bakeries were analysed for mycotoxins by TLC. Ochratoxin A was detected in one sample of bread from a domestic environment at a level of 0.21 mg/kg and in 2 samples of mouldy flour lumps at levels of 2.9 and 0.49 mg/kg. Citrinin was also detected in one of these samples of mouldy flour lumps but at levels that were too low to be quantitated. 2 separate domestic mouldy bread samples had TLC spots corresponding with patulin. VJG

6

[Residues in milk.] Situation und Bewertung von Rückständen in der Milch. [Lecture]

Heeschen, W.; Blüthgen, A.; Tolle, A.

Landwirtschaftliche Forschung, Sonderheft No. 36, 33-40 (1980) [4 ref. De] [Inst. für Hygiene der Bundesanstalt für Milchwissenschaft, Hermann-Weigmann-Str. 1/27, D-2300 Kiel, Federal Republic of Germany]

Since the establishment in 1973 of a legal max. concn. for chlorinated pesticides in animal products, the amount of residues in milk produced in the Federal Republic of Germany has decreased and in 1978 average concn. was <10% of the max. permitted concn. for all the pesticides monitored except for α - and β -HCH (30%) and lindane (20%). It was estimated that average intake of pesticides from milk (as a % of Acceptable Daily Intake) was for lindane 0.16%, heptachlor epoxide 0.45%, dieldrin 1.3%, DDT 0.26% and hexachlorobenzene 1.9%. The main problem of excessive residues in milk has come from α - and β -HCH which are constituents of products for the control of ectoparasites. In general the amount of heavy metals in milk is slight and the same applies to antibiotics and mycotoxins. Since the introduction of the brilliant black reduction test, the proportion of samples containing antibiotics has decreased to 2-4% of the total; the detected concn. of aflatoxin M in milk is 3-8 ng/kg. [See FSTA (1982) 14 1A23.] BWB

7

[Derivatization of ochratoxin A on a thin-layer chromatogram.] Zur Derivatisierung von Ochratoxin A auf der Dünnschichtplatte.

Kleinau, G.

Nahrung 25 (3) K9-K10 (1981) [3 ref. De] [Bezirks-Hygieneinspektion & Inst. Rostock, German Democratic Republic]

To reduce fluorescence interference during detection of ochratoxin A on thin layer chromatograms in UV light, esterification of the toxin was recommended. The sample is treated with a 30% ethanolic BF_3 solution on the TLC plate before separation using a benzene/methanol/glacial acetic acid (72:3:1 v/v) solvent system. Rf values were ochratoxin A, 0.1-0.2; ochratoxin A ethyl ester 0.6-0.7. The detection limit of ochratoxin A, as its ethyl ester, was 15 ng. IN

8

High performance liquid chromatographic preparation of alternariol, alternariol methyl ether, and altenuene.

Chu, F. S.; Bennett, S. C.

Journal of the Association of Official Analytical Chemists 64 (4) 950-954 (1981) [15 ref. En] [Dep. of Food Microbiol. & Toxicology, Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

A solvent system was developed for the isolation of 3 major *Alternaria* mycotoxins by HPLC. Alternariol, alternariol methyl ether and altenuene were purified using either a semipreparative or a preparative HPLC column. Gram quantities of pure mycotoxins were obtained in a single preparative HPLC step. Distribution of other individual mycotoxins and metabolites in various fractions obtained from either chromatographic procedure is discussed. AS

9

Aflatoxin inactivation in corn by ammonia gas: a field trial.

Brekke, O. L.; Peplinski, A. J.; Nofsinger, G. W.; Conway, H. F.; Stringfellow, A. C.; Montgomery, R. R.; Siluran, R. W.; Sohns, V. E.; Bagley, E. B.

Transactions of the ASAE 22 (2) 425-432 (1979) [40 ref. En]

Field trials were conducted on mycotoxin inactivation in corn by NH_3 to demonstrate the safety of NH_3 -detoxified corn to animals and of the edible animal tissues and products to humans, in order to obtain FDA approval of NH_3 -detoxified corn as an animal feed. The aflatoxin B_1 content of a 29 t batch of naturally contaminated corn was reduced from 750 to 7 $\mu\text{g}/\text{kg}$ by a recycle gas-phase treatment with 1.5% NH_3 . Total aflatoxin content was well below the FDA guideline of 20 $\mu\text{g}/\text{kg}$. Heated air drying as used for corn drying reduced water-extracted NH_3 content to 0.11%. RM

10

[Trends in mycotoxin research.] Trends in der Mykotoxinforschung. [Review]

Koch, H. A.; Kneist, S.; Rademacher, K.-H.

Lebensmittelindustrie 27 (10) 451-454 (1980) [36 ref. De, en, ru, fr] [Mykologische Abteilung, Hautklinik der Med. Akad., Erfurt, German Democratic Republic]

In this review, the occurrence of mycotoxins as a direct result of mould contamination in foods and feedstuffs is discussed, as well as their effects. Data are tabulated on important mycotoxins, their producers and effects, LD_{50} , formation of derived compounds, and their chemical/physical properties (including formulae, mol. wt., and melting point). Mycotoxin contamination of foods, e.g. fruit, fruit juices, cereals, and nuts, and of feedstuffs (fodder corn, straw) are discussed in depth. Mycotoxin transfer from acutely toxic feedstuffs into food products must also be considered, e.g. into cows milk, hens' eggs, muscle and fat tissue, and liver and kidneys of pigs and cows. Methods currently used for identification and quantitative detn. of mycotoxins are also discussed, with reference to their suitability and detn. limits; TLC is an important screening test method. IN

11

Contamination of food: mycotoxins and metals. [Review]

Gloag, D.

British Medical Journal 282 (6267) 879-882 (1981) [27 ref. En] [British Med. Ass., Tavistock Square, London WC1H 9JR, UK]

This review considers contamination of foods with mycotoxins (including ergot and aflatoxins), Hg and Cd, and covers foods commonly contaminated, levels of contamination, toxicological aspects, and the practical significance for human health. AJDW

12

[Problems with chromatographic determination of patulin in apple juices.] Zur Problematik der Patulinbestimmung in Apfelsäften mittels chromatographischer Methoden.

Blaicher, G.; Woidich, H.; Pfannhauser, W.

Ernährung 4 (5) 201-204 (1980) [20 ref. De, en] [Forschungsinst. der Ernährungswirtschaft, Blaasstrasse 29, 1190 Vienna, Austria]

A brief discussion is given of the structure, toxicity and occurrence of patulin; limitations of TLC and GLC methods for detn. of patulin are discussed. An HPLC method is described, based on isolation of patulin by column chromatography on celite (elution with chloroform) and analysis of the extract by HPLC on a silica gel column, using diisopropyl ether/tetrahydrofuran (95:5), with the addition of 0.1% acetic acid, as the mobile phase. Use of 3 such columns in series gives acceptable separation of the patulin peak from interfering peaks. The patulin peak is determined by spectrophotometry at 280 nm and 254 nm. AJDW

13

Mycotoxin production in whole tomatoes, apples, oranges, and lemons.
Stinson, E. E.; Osman, S. F.; Heisler, E. G.; Siciliano, J.; Bills, D. D.

Journal of Agricultural and Food Chemistry 29 (4) 790-792 (1980) [8 ref. En] [E. Reg. Res. Cent., USDA, Philadelphia, Pennsylvania 19118, USA]
Production of mycotoxins in whole tomatoes, apples, oranges, and lemons infected with *Alternaria* indigenous to these fruits was demonstrated for the first time. Tenuazonic acid (TeA) was the main mycotoxin produced in *Alternaria*-infected tomatoes from commercial sources. 11 of 19 tomatoes contained TeA with concn. as high as 13.9 mg/100 g. Much smaller amounts of alternariol (AOH), alternariol monomethyl ether (AME), and altenuene (ALT) were present, while sterigmatocystin (STC) was absent. AOH and AME were the major mycotoxins produced in *Alternaria*-infected apples from commercial sources, with max. concn. of 5.8 and 0.23 mg/100 g, resp. Much smaller concn. of TeA, ALT, and ATX-I were present. In oranges, the reponderant mycotoxins that were produced were TeA, AME, and AOH with average concn. of 2.66, 1.31, and 1.15 mg/100 g, resp. Small amounts of ALT and ATX-I were present in all infected oranges. The production of mycotoxins in inoculated lemons was similar to that in oranges. AS

14

Reduction of ochratoxin contamination in cereals by technological processing.
Chelkowski, J.; Golinski, P.; Godlewska, B.; Radomska, W.

Przegląd Zbozowo-Młynarski 24 (6) 6-7 (1980) [5 ref. Pl] [Inst. Tech. Żywności Pochodzenia Roslinnego AR, Poznań, Poland]

Ochratoxins are found in 5-7% of cereal samples. They are the products of invisible mould infection of cereals. It was established that ochratoxins diffuse into the grain but are primarily found in the surface layers. During processing of groats, 70-90% of the ochratoxins are separated with the husks, while up to 50% of ochratoxins may be contained in flour. STI

15

Relation of wheather variables to incidence of zearalenone in corn in Southern Ontario.

Hutton, J. C.; Baliko, W.; Funnell, H. S.
Canadian Journal of Plant Science 60 (1) 149-155 (1980) [12 ref. En] [Dep. of Environmental Biol., Ontario Agric. Coll., Univ. of Guelph, Guelph, Ontario N1G 2W1, Canada]

Incidence of zearalenone was estimated according to frequency with which the mycotoxin was detected in corn (*Zea mays* L.) samples received for mycotoxin analyses at the Veterinary Services Laboratory, in Guelph, Ontario. Sampling periods were 1 Sept. to 1 May in 6 successive yr. Frequency of zearalenone was high in 1975-76, moderate in 1972-73, 1976-77 and 1977-78, and low in 1973-74 and 1974-75. Incidence of zearalenone-positive samples for each 10⁴ ha grain corn was highest in a zone extending from the Bruce Peninsula to the Niagara region. Incidence of

zearalenone-positive corn samples correlated strongly with rainfall for Aug., but only moderately or weakly with rainfall for July, Sept. and Oct. Rain promoted zearalenone accumulation indirectly by favouring epidemic development in corn of the mycotoxigenic fungus *Fusarium graminearum*. Correlations between zearalenone frequencies and temp. were weak. Persistent wetness in corn increased ear rot development and incidence of zearalenone. AS

16

[A method for TLC determination of HT-2 toxin in maize.] Eine Methode zur dünn-schichtchromatographischen Bestimmung von HT-2-Toxin in Mais.

Gruber, S.; Paolis, V. de
Landwirtschaftliche Forschung 33 (4) 436-439 (1980) [9 ref. De, en, fr] [Staatliche Landw. Untersuchungs- & Forschungsanstalt, D-7500 Karlsruhe 41, Federal Republic of Germany]

A method is described for the detn. of HT-2 toxin (a mycotoxin of the 12,13-epoxytrichothecene group, formed by various *Fusarium* spp.). It involves extraction with (NH₄)₂SO₄-saturated acetone, purification with hexane and chloroform, TLC on silica gel G, and detn. by UV-fluorescence. Recovery from 8 samples spiked with 300 µg/kg was 250-313, mean 274 (83-104%, mean 91%), coeff. of variation 10.2%. Limit of detection is 300 parts/billion. RM

17

[Mycotoxins in foods: occurrence and determination.] Mycotoxine in Lebensmitteln - Vorkommen und Bestimmung. [Review]
Weber, R.

Lebensmittelchemie und Gerichtliche Chemie 35 (4) 71-76 (1981) [36 ref. De] [Bundesgesundheitsamt, Max-von-Pettenkofer-Inst., Postfach 33 00 13, 1000 Berlin 33]

Aspects considered in this review include: methods for analysis of aflatoxins in foods, and their advantages and limitations; aflatoxin concn. in various foods; occurrence of patulin in apple products and other foods, and its HPLC, TLC and GLC analysis; ochratoxin A in foods; and methods for simultaneous detn. of a range of mycotoxins. AJDW

18

[Up to date facts on mycotoxins.]

Akrida-Demertze, K.; Demertze, P.; Boudoure, E.
Hemika Hronika 46 (1) 32-39 (1981) [32 ref. Gr, en] [Chair of Food Chem., Univ. of Ioannina, Greece]

Recent knowledge on the old problem of health hazards caused to man and animals by consuming food infected by several species of moulds is reviewed. The upper acceptable levels of mycotoxins in food are given and analytical methods available for detn. of mycotoxins are outlined. Finally, methods of facing the mycotoxin problem are proposed. AS

19

[Patulin in products of vegetable origin.] Patulin in Produkten pflanzlicher Herkunft. [Review] Frank, H. K.

Confructa 25 (3/4) 107-118 (1980) [88 ref. De] [Inst. für Biol., Bundesforschungsanstalt für Ernährung, Karlsruhe, Federal Republic of Germany]

Aspects covered in this review of patulin include chemical properties, biosynthesis, detection procedures, conditions for its formation, its occurrence in products of vegetable origin, notably fruits, and its degradation by natural process (e.g. fermentation) in manufactured products, such as fruit juices or apple puree. Tabulated data are included on patulin concn. found in apple juice from 15 domestic or commercial sources in 8 countries in harvests from 1970 to 1978; and in another table on its toxicity (for mice and domestic fowl) compared with that of 9 fungicides and preservatives. However, it is emphasized that large intakes (4.5 l fruit/juice/day) would be necessary for any harmful effect on humans. KME

20

[Detection and semi-quantitative determination of patulin in apple juice.]

Czerwiecki, L.

Roczniki Panstwowego Zakladu Higieny 31 (3) 271-275 (1980) [16 ref. Pl, ru, en] [Panstwowy Zaklad Higieny, 00-791 Warsaw, Poland]

The method of Scott & Kennedy [FSTA (1973) 5 11H1816] modified by uni-directional development of chromatogram with 2 solvents (chloroform/glacial acetic acid/diethyl ether at 68:4:12, and chloroform/acetone at 9:1), and replacement of Merck silica gel by Adsorbosil 1 (Applied Science Laboratories, Inc.) was used. Recovery of patulin added to apple juice at 25, 50, 100 or 200 µg/l was 62.5, 74.5, 76.0 and 87.8% resp. The sensitivity of the method was found to be 25 µg/L. No patulin was detected by this method in 10 samples of Bulgarian apple juice, 20 of apple juice concentrate, 6 of 'Frument' beverage, and 6 of a Polish 'apple beverage'. SKK

21

Mycotoxins in stored rice.

Gangopadhyay, S.; Chakrabarti, N. K.

Current Science 50 (6) 272-275 (1981) [13 ref. En] [Cent. Rice Res. Inst., Cuttack-753 006, India]

8 month old (i) raw (ii) single and (iii) double parboiled rice collected from different villages in Orissa state were evaluated for mycotoxins. Results showed that the moisture of (iii) was 20.5 to 22.5% compared to 13.5 to 19.5% in (ii) and 12.3 to 17.5% in (i). *Aspergillus flavus* and *Fusarium moniliforme* contaminated 22.4-29.2 and 23.8-32.5% in (iii), 17.9-24.5% and 22.5-30.8% in (ii) and 12.9-19.5 and 19.8-30.5% in (i) resp. Aflatoxin B₁ from rice infected with *A. flavus* was identified spectrophotometrically and by TLC. Toxin extracted from rice infected with *F. moniliforme* yielded yellow crystals with scanning spectrophotometric peaks between 227 nm and 323 nm, the absorption wave numbers being 47260 and 58358, max. fluorescence emission 450 nm and R_f value on silica gel 0.68. This unidentified toxin seemed to be very close to zearalenone. Toxicity of the above toxins was also evaluated using rabbits. CFTRI

22

Laboratory screening for zearalenone formation in corn hybrids and inbreds.

Shannon, G. M.; Shotwell, O. L.; Lyons, A. J.; White, D. G.; Garcia-Aguirre, G.

Journal of the Association of Official Analytical Chemists 63 (6) 1275-1277 (1980) [11 ref. En] [N. Reg. Res. Cent., USDA, Peoria, Illinois 61604, USA]

Results of previous studies have suggested that some corn var. infected with *Fusarium graminearum* (perfect stage *Gibberella zeae*) may have the ability to inhibit production of the mycotoxin zearalenone by this mould. The study reported in this paper examined this suggestion. Zearalenone-free grain (equilibrated to 45% moisture) of 14 corn inbreds and 4 single cross hybrids was inoculated with 3 isolates of *F. graminearum*, then incubated for 3 wk at 25°C; the grain samples were then extracted, cleaned up and analysed for zearalenone by densitometric examination of TLC plates. Levels found are tabulated. The results obtained indicated that: the amount of visible fungal growth does not correlate with the amount of zearalenone produced; the hybrids appear to have less resistance than the inbreds to zearalenone formation; and the 3 *F. graminearum* isolates vary in their ability to produce zearalenone. JA

23

Mycotoxins in cereal grain. I. Ochratoxin, citrinin, sterigmatocystin, penicillic acid and toxigenic fungi in cereal grain.

Szebiotko, K.; Chelkowski, J.; Dopierala, G.; Godlewska, B.; Radomska, W.

Nahrung 25 (5) 415-421 (1981) [11 ref. En, de, ru] [Inst. of Food Tech. of Plant Origin Commodities, Agric. Univ., Poznan, Poland]

Contamination, mainly with ochratoxin A but also with citrinin, penicillic acid and sterigmatocystin was observed in mouldy cereal grain samples (wheat, rye and barley), during 1975-1978. The levels of grain contamination differed considerably between years. Two months after harvest, % contaminated samples was 5-7%; ochratoxin A content was ≤ 140 µg/kg. During storage of grain with high moisture content slow increase of contamination level was observed, particularly during Jan. and Feb. to a level of 1-3 mg/kg. Grain from commercial channels was contaminated with fungi spores at counts up to 109/g. *Aspergillus* and *Penicillium* predominated. Of 69 fungi isolates typical for barley kernels, 13 were producers of ochratoxin, sterigmatocystin, penicillic acid and F-2-toxin. [See following abstr. for part II.] AS

24

Mycotoxins in cereal grain. II. The fate of ochratoxin A after processing of wheat and barley grain.

Chelkowski, J.; Golinski, P.; Godlewska, B.; Szebiotko, K.

Nahrung 25 (5) 423-426 (1981) [6 ref. En, de, ru] [Inst. of Food Tech. of Plant Origin Commodities, Agric. Univ., Poznan, Poland]

Studies were conducted on concn. of ochratoxin A in commercial samples of wheat and barley, and on changes in ochratoxin A concn. in wheat and barley as a result of various processing operations. Numerous tables of results are given. Ochratoxin concn. differed little between the batches of grain studied. Neither dry nor wet cleaning had major effects on ochratoxin

concn. Only 50% of the ochratoxin in the grain could be extracted from the surface of the grain. Milling trials showed ochratoxin concn. to be approx. equal in the flour and in the bran. Pearl barley had a relatively low ochratoxin concn., whereas the bran removed during pearling had a high ochratoxin concn. It is concluded that normal processing methods do not give adequate detoxification of ochratoxin-contaminated grain. [See preceding abstr. for part I.] AJDW

25

Comparative metabolism of zearalenone and transmission into bovine milk.

Mirocha, C. J.; Pathre, S. V.; Robison, T. S.

Food and Cosmetics Toxicology 19 (1) 25-30 (1981) [7 ref. En] [Dep. of Plant Path., Univ. of Minnesota, St Paul, Minnesota 55108, USA]

Metabolism of zearalenone (Z) in the urine of the cow, pig, rabbit, rat and man was studied. In addition, transfer of Z into cows' milk was measured after feeding a lactating cow a diet containing 25 p.p.m. Z for 9 days for 250 p.p.m. for 22 days (approx. 200 mg and 1 g Z/day, resp.). Total concn. of Z (in the free form or as the glucuronide or sulphate conjugate) in milk samples collected after 7 days of feeding 25 p.p.m. was 1.36 p.p.m., and after 1 and 2 days of feeding 250 p.p.m. were 0.16 and 0.44 p.p.m., resp. Calculation indicated that this represented approx. 0.7% of dietary Z. The Z, α -zearalenol and β -zearalenol constituted approx. 35, 31 and 34%, resp., of the free metabolites. DMK

26

[Selection of method for detection of ochratoxin A in kidneys.]

Bartos, J.; Matyas, Z.

Veterinarni Medicina 26 (2) 117-121 (1981) [22 ref. Cs, ru, en, de] [Vyzkumny Ustav Vet. Lekarstvi, 62132 Brno, Czechoslovakia]

A method based on those of Nesheim et al. [FSTA (1973) 5 11M1420], Trenk & Chee [FSTA (1972) 4 4C95], and Krogh et al. [Acta Pathologica et Microbiologica Scandinavica, B (1974) Suppl. 246, 21] is described in detail. The sensitivity is 2 μ g ochratoxin A/kg tissue. (i) 30 pig kidney samples from normal slaughter, and (ii) 20 from emergency slaughter in 3 slaughterhouses were examined by this method; no ochratoxin A was detected in (i); 2 of the (ii) samples contained 3 μ g/kg. SKK

27

High-performance liquid chromatography of trichothecenes. I. Detection of T-2 toxin and HT-2 toxin.

Schmidt, R.; Ziegenhagen, E.; Dose, K.

Journal of Chromatography 212 (3) 370-373 (1981) [9 ref. En] [Inst. für Biochem., Joh. Gutenberg Univ. Mainz, Joh. Joachim Becher Weg 30, 65 Mainz, Federal Republic of Germany]

The fungi *Fusarium tricinctum*, *F. solani* and *F. sporotrichioides* produce the highly toxic trichothecenes diacetoxyscirpenol, T-2 toxin and HT-2 toxin. Previous studies have indicated that classical

separation and detn. procedures cannot be easily applied to these trichothecenes. This paper reports studies which utilized HPLC for their separation and detn. HPLC separation was performed on previously described apparatus [see FSTA (1981) 13 9C294]. Differential refractometry was used to detect the trichothecenes; this procedure proved suitable for detecting as little as 1 μ g T-2 toxin/injection at the highest detector sensitivity up to semipreparative quantities of about 1 mg. During HPLC, the retention times of the 3 trichothecenes were found to be affected by the methanol concn. in the methanol-water solvent system. Retention times for solvent containing 60% methanol were highly reproducible. 2 more metabolites produced by the *Fusarium* spp. were detected on the HPLC chromatogram; both have been preliminary classified as trichothecenes. JA

28

Negative ion chemical ionization mass spectrometry of aflatoxins and related mycotoxins.

Brumley, W. C.; Nesheim, S.; Trucksess, M. W.; Trucksess, E. W.; Dreifuss, P. A.; Roach, J. A. G.; Andrzejewski, D.; Eppley, R. M.; Pohland, A. E.; Thorpe, C. W.; Sphon, J. A.

Analytical Chemistry 53 (13) 2003-2006 (1981) [18 ref. En] [Div. of Chem. & Physics, FDA, Washington DC 20204, USA]

Negative ion chemical ionization mass spectra of aflatoxins and other mycotoxins were obtained under resonance electron capture conditions using methane. The negative ion spectra of aflatoxins consisted of 3 major ions: M^- , $(M-H)^-$, and $(M-CH_3)^-$. Other mycotoxins related to aflatoxins also exhibited relatively simple spectra. The temp. dependence of the spectra is presented in detail for aflatoxin B₁. The negative ion spectra of aflatoxins were used to demonstrate the feasibility of confirming the presence of aflatoxin B₁ in peanut butter, corn, and other commodities and aflatoxin M₁ in milk after appropriate extraction-cleanup. The aflatoxins were confirmed at levels as low as 10.5 parts/billion in food matrices. AS

29

Isolation of citreoviridin from *Penicillium charlesii* cultures and molded pecan fragments.

Cole, R. J.; Dorner, J. W.; Cox, R. H.; Hill, R. A.; Cluter, H. G.; Wells, J. M.

Applied and Environmental Microbiology 42 (4) 677-681 (1981) [22 ref. En] [Nat. Peanut Res. Lab., USDA, Dawson, Georgia 31742, USA]

Extraction and systematic fractionation of *Penicillium charlesii* Smith cultures and contaminated pecan fragments yielded the yellow mycotoxin citreoviridin. Citreoviridin proved acutely toxic to 1-day-old chickens, with an oral LD₅₀ of 37.5 mg/kg, and showed plant growth inhibition in wheat coleoptiles even at concn. as low as 10⁻⁴ M. AS

30

Determination of patulin and penicillic acid in unroasted cocoa beans.

Chaytor, J. P.; Saxby, M. J.

Journal of Chromatography 214 (1) 135-139 (1981) [7 ref. En] [Leatherhead Food R. A.; Randalls Road, Leatherhead, Surrey KT22 7RY, UK]

Detection of patulin and penicillic acid (possible mycotoxins produced by fungi) has been successfully studied in some foods, but interference from phenolic material necessitated a new method for unroasted cocoa beans. A method is described, based on extraction of the beans with ethyl acetate, evaporation at 40-45°C, partition between water (5 ml) and hexane (10 ml), evaporation of the aqueous layer under vacuum at 65-70°F and silylation with methanol and *N*-methyl-*N*-trimethyl silyltrifluoroacetamide, followed by GLC-MS determination of the silylated toxins. Chromatograms are given, together with the recovery of patulin and penicillic acid. Detection limits are estimated to be about 20 µg/kg for patulin and 10 µg/kg for penicillic acid. ELCC

31

Metabolic-fate of T-2 toxin in a lactating cow.

Yoshizawa, T.; Mirocha, C. J.; Behrens, J. C.; Swanson, S. P.

Food and Cosmetics Toxicology 19 (1) 31-39 (1981) [26 ref. En] [Dep. of Plant Path., Univ. of Minnesota, St Paul, Minnesota 55108, USA]

Unlabelled T-2 toxin, a trichothecene mycotoxin produced by species of *Fusarium*, was administered orally by capsule to a lactating Jersey cow for 3 days (180 mg/day). On day 4, the cow received a single oral dose of powdered ³H-labelled T-2 toxin (0.171 mCi/kg body wt.). Treatments were equivalent to dietary concn. of 31-36 p.p.m. T-2 toxin. Peak radioactivity in milk was reached after 16 h (0.037 p.p.m.). By 72 h almost all radioactivity had been eliminated in urine and faeces, with only 0.2% of the dose transmitted into milk. TLC analysis showed that T-2 toxin was rapidly metabolized, yielding principally 3 major unknown metabolites (designated TC-1, TC-3 and TC-6) in addition to very polar metabolite(s) designated TC-8. The TC-1, TC-3 and TC-6 accounted for about 60-70% of extractable metabolites in milk samples up to 36 h after dosing. DMK

32

Conditions for formation of patulin in dry sausages.]

Labie, C.; Tache, S.

Bulletin de l'Academie Veterinaire de France 53 (3) 389-396 (1980) [28 ref. Fr, en] [Ecole Nat. Vet., Toulouse, France]

Studies on occurrence of patulin in dry sausages are described, with special reference to conditions for formation of patulin by *Penicillium granulosum*. The results show that the most favourable conditions for growth of *P. granulosum* are: temp. 20-26°C; RH 80-86%; moisture content of substrate (defatted basis) > 60%. Growth may occur at temp. as low as 15°C, if

RH is 86%. Analysis of sausages showing abundant growth of a highly toxigenic strain of *P. granulosum* revealed presence of only traces of patulin, suggesting that patulin is inactivated by sausage constituents. Studies were conducted to evaluate inactivation of patulin in sausage mix. 6250 parts/billion (p.p.b.) of patulin were added to a sausage mix, and changes in patulin concn. were studied over the following 24 h. The results show rapid inactivation of patulin, concn. decreasing to 300 p.p.b. after 8 h, and to approx. zero well within 24 h. Feeding trials with mice showed no adverse effects of the consumption of this sausage mix. AJDW

33

Residues of meats and additives - studies and perspectives. (In 'Meat in nutrition and health' [see FSTA (1982) 14 4S569]) [Lecture]

Ferrando, R.

pp. 151-176 (1981) [88 ref. En] [Lab. of Nutr. & Feeding, Nat. Vet. Coll., Alfort, France]

This review deals with the sources and hygienic risk of residues in meat, under headings of: residues originating from natural contaminants owing to the infestation of the animals' food by microorganisms productive of mycotoxins; residues originating from pesticides used in agriculture and reaching meats by way of the alimentary chain - the case of heavy metals is also examined; residues originating from additives used in animal feed and medication used in veterinary therapy; substances used in the preparation of meat products, especially pork butchery; perspectives raised by the question of residues on material, sanitary and legislative levels, involving the necessity for a total, objective study. LH

34

Applications of HPLC.

Battaglia, R.

Ernährung 5 (2) 57-60 (1981) [En] [Direktion des Gesundheitswesens, Kantonales Lab. Zurich, Fehrenstrasse 15, CH-8032 Zurich, Switzerland]

Food analysis by HPLC is discussed with reference to basic analytical problems (sample preparation, suitable clean-up). Examples include analysis of patulin in apple juice and biogenic amines in beer and wine. RAW

35

Methods for the determination of mycotoxins.

Hunt, D. C.

Analytical Proceedings 18 (11) 471-472 (1981) [8 ref. En] [Lab. of the Gov. Chem., Cornwall House, Stamford Street, London SE1 9NQ, UK]

This paper discusses the effects of and methods of detn. for aflatoxins, ochratoxin A and other mycotoxins, with special attention to HPLC methods. RM

36

[The mycotoxin problem in tropical countries.]

Ruggiero, M.; Nicastro, C.

Rivista di Agricoltura Subtropica e Tropicale 74 (3/4) 221-230 (1980) [10 ref. It, en, de]

The dangers to man and animals presented by fungal contamination and mycotoxin production of stored vegetable foods and feeds are surveyed with special reference to tropical conditions. RM

37

Mycotoxins other than aflatoxins - their relationships to food safety. [Conference proceedings] United States of America, American Society for Microbiology

Journal of Food Protection 44 (9) 701-726 (1981) [many ref. En]

4 papers are published that were presented at a symposium held during the 80th Annual Meeting of the American Society for Microbiology, 11-16 May 1980, at Miami Beach, Florida. An introduction, by L. B. Bullerman and R. L. Buchanan (pp. 701, 710) precedes the papers, which can be found in the FSTA author index under **United States of America**, American Society for Microbiology [Mycotoxin Symposium]. DIH

38

Sterigmatocystin and other mycotoxins produced by *Aspergillus* species. [Lecture]

Davis, N. D.

Journal of Food Protection 44 (9) 711-714, 722 (1981) [29 ref. En] [Dep. of Botany, Plant Path. & Microbiol., Auburn Univ., Auburn, Alabama 36849, USA]

A review is made of the food toxicants sterigmatocystin and ochratoxin A, covering biological effects, causative organisms, natural occurrence of the organisms and the toxins and analytical methods. Other *Aspergillus* toxins, whose significance as hazards to human health is less understood, are listed. [See FSTA (1982) 14 5C196.] DIH

39

Fungal tremorgens. [Lecture]

Cole, R. J.

Journal of Food Protection 44 (9) 715-722 (1981) [39 ref. En] [Nat. Peanut Res. Lab., USDA, PO Box 637, Dawson, Georgia 31742, USA]

Chemical structures of known fungal tremorgens are illustrated, and the microorganisms that give rise to them are listed. Animal diseases caused by ingestion of tremorgen-contaminated fodder are discussed. Some of the microorganisms are known to contaminate human foods and tremorgens therefore pose a potential direct threat to human health; indirect contamination of food (residues in tissues of animals that ingested tremorgens) has apparently been little studied. [See FSTA (1982) 14 5C196.] DIH

40

[Mycotoxin-forming moulds as agents of fruit decay.] Mykotoxinbildende Schimmelpilze als Verderber von Früchten. [Review]

Frank, H. K.

Erwerbsobstbau 22 (9) 196-199 (1980) [48 ref. De] [Inst. für Biologie, Bundesforschungsanstalt für Ernährung, 7500 Karlsruhe 1, Federal Republic of Germany]

Aspects covered in this review of microbial fruit decay include: the fungi acting as toxinogenic agents of fruit decay, and toxicity of the various toxins produced; routes of infection; consequences of toxin-containing mouldy fruit, including patulin in juices and economic consequences for the fruit producer; and possibilities of prevention of mycotoxin formation. DIH

41

[Formation of mycotoxin in mouldy fruit.] Zur Bildung von Mycotoxinen in befallenen Früchten. [Review]

Röschenthaler, R.

Erwerbsobstbau 22 (10) 222-226 (1980) [42 ref. De] [Inst. für Mikrobiologie, Univ. Münster, 4400 Münster, Federal Republic of Germany]

After a discussion of formation of mycotoxins in general, this review covers the following aspects: mycotoxins actually found in fruits; patulin in fruits and fruit juices; detection of patulin and quantities present; aflatoxins in fruits; and prevention of contamination of fruits with mycotoxins. DIH

42

[Determination of T-2-toxin in vegetable foods. I. T-2 toxin in mouldy rice and maize.] Bestimmung von T-2-Toxin in pflanzlichen Nahrungsmitteln. I. T-2-Toxin in verschimmelten Reis und Mais.

Schmidt, R.; Bieger, A.; Ziegenhagen, E.; Dose, K.

Zeitschrift für Analytische Chemie 308 (2) 133-136 (1981) [20 ref. De, en] [Johannes Gutenberg-Univ., D-6500 Mainz, Federal Republic of Germany]

A procedure is described for detn. of T-2-toxin in extracts from mouldy rice and maize by TLC and fluorescence intensity measurement of the H₂SO₄-treated TLC plates. Fluorescence absorption and emission spectra are presented. Relation of mycotoxin concn. to fluorescence intensity is described by an equation. Identity of T-2-toxin is confirmed by formation of a blue derivative with 4-(p-nitrobenzyl)pyridine. Recoveries of 500 µg T-2-toxin added to ground rice gave an analytical error of < 10%. A straight line standard curve was obtained for concn. of 100 ng-l µg. A greater concn. range (0.1-20 µg) was determined with the aid of a computer. [From En summ.] RM

43

Simultaneous detection of several *Fusarium* mycotoxins in cereals, grains, and foodstuffs.

Kamimura, H.; Nishijima, M.; Yasuda, K.; Saito, K.; Ibe, A.; Nagayama, T.; Ushiyama, H.; Naoi, Y.

Journal of the Association of Official Analytical Chemists 64 (5) 1067-1073 (1981) [11 ref. En] [Tokyo Metropolitan Res. Lab. of Public Health, 24-1 Hyakunin-cho 3-chome, Shinjuku-ku, Tokyo 160, Japan]

A systematic method is described for the simultaneous detn. of *Fusarium* mycotoxins (nivalenol, deoxynivalenol, fusarenone-x, diacetoxyscirpenol, neosolaniol, T-2 toxin, HT-2 toxin, butenolide, moniliformin, and zearalenone) in cereals, grains, and foodstuffs. Mycotoxins were extracted with aqueous methanol and purified by a 2-step chromatographic procedure using Amberlite XAD-4 and Florisil columns. The column eluates were concentrated and spotted on a TLC plate which was then developed in chloroform/methanol (93 + 7) and toluene/acetone/methanol (5 + 3 + 2). Each mycotoxin was quantitated by GLC and TLC densitometry. The min. detectable concn. ($\mu\text{g/kg}$) in various test materials were: nivalenol, deoxynivalenol, and fusarenone-x, 2.0; diacetoxyscirpenol, neosolaniol, T-2 toxin, and HT-2 toxin, 80; zearalenone, 10; butenolide, 30; and moniliformin, 50. Recoveries of the mycotoxins added to various cereal samples at 1.0–2.0 $\mu\text{g/g}$ were > 71% and averaged 85%. AS

4.4

Gas chromatography with electron capture and mass spectrometric detection of deoxynivalenol in wheat and other grains.

Scott, P. M.; Lau, P.-Y.; Kanhere, S. R.

Journal of the Association of Official Analytical Chemists 64 (6) 1364–1371 (1981) [24 ref. En] [Health Protection Branch, Health & Welfare Canada, Ottawa, Ontario, Canada]

A method for determining deoxynivalenol (DON) in wheat was developed in conjunction with an assessment of contamination in Canada. The sample is extracted with methanol/water; the extract is treated with 30% aqueous $(\text{NH}_4)_2\text{SO}_4$ solution and extracted with 4 portions of ethyl acetate. After further cleanup by column chromatography, the sample extract is derivatized with *N*-heptafluorobutyrylimidazole, and the DON tris-heptafluorobutyrate is determined by GLC with electron capture detection. Mass spectrometric single ion monitoring at m/z 884 is used for confirmation. Detection limits are $\leq 0.01 \mu\text{g DON/g}$ and recoveries from wheat, using the proposed method, averaged 72 and 80% in 2 different laboratories, with coeff. of variation of 10.2 and 10.0%, resp. The method is also applicable to determining DON in barley and corn and T-2 toxin in wheat. Virtually 100% contamination by DON of the 1980 Ontario white winter wheat and Quebec red spring wheat crops was found, based on 72 analyses made in this laboratory, but western Canadian wheat contained little or no DON. AS

45

[Gas chromatographic determination of trichothecene mycotoxins in food.]

Koroda, H.; Mori, T.; Nishioka, C.; Okasaki, H.; Takagi, M.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 20 (2) 137–142 (1979) [5 ref. Ja, en] [Kagawa Pref. Inst. Public Health, Matsushima-cho, 1-chome, Takamatsu-shi, Kagawa-ken, Japan]

Trichothecenes were converted to their trimethylsilyl (TMS) derivatives and analysed by GLC with electron capture detection. Min. limits of quantitation were 0.002 ng for nivalenol, deoxynivalenol and fusarenone-X, and 0.4 ng for neosolaniol, diacetoxyscirpenol and T₂-toxin. Trichothecenes in samples of wheat and barley were detected in the range 0.02–5.2 p.p.m. TM

46

Radioimmunoassay of T-2 toxin in biological fluids.

Lee, S.; Chu, F. S.

Journal of the Association of Official Analytical Chemists 64 (3) 684–688 (1981) [21 ref. En] [Dep. of Food Microbiol. & Toxicology, Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

A simple radioimmunoassay (RIA) for detection of T-2 toxin in biological fluids was developed. The method, which involves a Sep-Pak C₁₈ reversed phase column cleanup step before RIA, can detect 2.5 ng T-2 toxin/ml milk. Recoveries for toxin added to urine or milk samples were 88–117% in the 2.5–20 ng/ml range. If samples were not cleaned up, false positive results prevented positive detection at concn. < 2.5 ng/ml. urine and milk. AS

47

[Mycotoxins in cheese.] [Review]

Josefsson, E.

Var Föda 33 (6) 237–248 (1981) [43 ref. Sv, en] [Livsmedelslab., Statens Livsmedelsverk, 751 26 Uppsala, Sweden]

The literature on mycotoxins in cheese is reviewed, with a comprehensive tabular compilation of data on mycotoxins in blue veined cheese, Camembert cheese and cheeses contaminated with adventitious moulds. In blue-veined and Camembert cheese, toxins such as roquefortine, isofumigaclavin A or B, mycophenolic acid and cyclopiazonic acid may be formed by the *Penicillium roqueforti* and *P. camemberti* cultures added to the cheese milk during manufacture. In other cheeses, mycotoxins may originate from the primary production of milk on the farm (especially aflatoxin M₁) or from adventitious moulds which grow on the cheese during storage (e.g. sterigmatocystin formed by *Aspergillus versicolor*). The spread of toxins from mouldy parts of the cheese is discussed, and factors affecting mould growth and toxin formation are considered. Finally, details are given of the toxic properties of the main mycotoxins (aflatoxin B₁ and M₁, cyclopiazonic acid, etc.). ADL

48

Toxins of *Penicillium* species used in cheese manufacture. [Lecture]

Scott, P. M.

Journal of Food Protection 44 (9) 702–710 (1981) [107 ref. En] [Food Directorate, Health Protection Branch, Health & Welfare Canada, Ottawa, Ontario, Canada K1A 0L2]

The known metabolites of strains of *Penicillium roqueforti* associated with blue-veined cheeses are penicillic acid, roquefortine, isofumigaclavines A and B, PR toxin and related metabolites, mycophenolic acid and siderophores. Of these, penicillic acid and PR toxin, one of the most acutely toxic metabolites of *P. roqueforti*, are unstable in cheese. Roquefortine, isofumigaclavine A, mycophenolic acid and the siderophore ferrichrome have been detected in blue cheese at low p.p.m. levels. Cyclopiazonic acid is a metabolite of *P. caseicolum* (*P. camemberti*), the fungus used in the manufacture of Camembert-type cheeses. Low concn. of this mycotoxin have been detected in the cheese crusts. Although no acute health hazard can be identified from the presence of these known fungal metabolites in mould-ripened cheeses, there are conflicting reports on the carcinogenicity of *P. camemberti* cultures and one report on sub-acute toxicity of lipids from an Egyptian blue cheese. [See FSTA (1982) 14 5C196.] AS

49

Caffeine inhibition of ochratoxin A production.

Buchanan, R. L.; Tice, G.; Marino, D.

Journal of Food Science 47 (1) 319-321 (1982) [En]
[USDA-SEA-ARS, E. Reg. Res. Cent., 600 E. Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

Effect of caffeine and theobromine on growth and ochratoxin A production by *Aspergillus ochraceus* was determined using a microbiological medium. Caffeine produced a small decrease in growth, while reducing ochratoxin production as much as 98%. Theobromine had relatively little effect on growth or ochratoxin production. Screening of caffeine for its effect on the growth of a number of *Aspergillus* and *Penicillium* spp. indicated that caffeine may have biological activity against a variety of mycotoxigenic moulds. IFT

50

Survey of selected mycotoxins in food.

Fritz, W.; Engst, R.

Journal of Environmental Science and Health, B B16 (2) 193-210 (1981) [31 ref. En] [Cent. Inst. of Nutr. of the Academy of Sci. of the GDR, Potsdam-Rehbrücke, 1505 Bergholz-Rehbrücke, Arthur-Scheunert-Allee 114-116, German Democratic Republic]

Aflatoxins B₁, B₂, G₁, G₂, and M₁, ochratoxin A, patulin, and byssochlamic acid were analysed in various foods by solvent extraction; purification by TLC or column chromatography; separation by 2-dimensional TLC; detn. by fluorescence densitometry and

spectrophotometric fluorimetry. Results are tabulated. Foods examined (moulded and nonmoulded) included: peanuts and peanut products, milk and dairy products, grain and cereal products, fruit and fruit products, and coffee. Toxicological consequence of mycotoxins in food, and possibilities to reduce present levels in food are discussed. LH

51

Fluorodensitometric determination of trichothecene mycotoxins with nicotinamide and 2-acetylpyridine on a silica gel layer.

Sano, A.; Asabe, Y.; Takitani, S.; Ueno, Y.

Journal of Chromatography 235 (1) 257-265 (1982) [12 ref. En] [Fac. of Pharmaceutical Sci., Sci. Univ. of Tokyo, 12, Ichigaya-funagawara-machi, Shinjuku-ku, Tokyo 162, Japan]

A fluorodensitometric method for detn. of trichothecene mycotoxins on silica gel thin-layer plates based on a fluorescence reaction of the epoxy group with nicotinamide and 2-acetylpyridine is described. Application of the method directly to trichothecenes in agricultural products (corn) was unsuccessful because several interfering materials prevented detection of the spots, hence some clean-up step is necessary prior to practical analyses. AL

52

[The principal mycotoxins and their importance in foods.] [Review]

Bechet, J.; Thonart, P.

Actualites Scientifiques et Techniques dans les Industries Agro-alimentaires, Centre de Documentation Internationale des Industries Utilisatrices de Produits Agricoles No. 20, 166pp. (1978) [441 ref. Fr]

This publication gives extensive reviews on the main mycotoxins, organisms producing them, conditions for toxin production, structure, toxicity/carcinogenicity, foods susceptible to contamination, and methods for detection and analysis. Mycotoxins considered include aflatoxins, sterigmatocystin, ochratoxins, toxins formed by *Fusarium* spp. (trichothecenes, zearalenone and its derivatives), patulin, penicillic acid, citrinin, 'yellow rice' toxins, ergot, rubratoxins, *Alternaria* spp. toxins, tremorgens, *Penicillium roqueforti* toxin, sporidesmins, malformins, and *Byssoschlamys* spp. toxins. A]DW

53

A critical review of biological methods for the detection of fungal toxins in foods and foodstuffs. [Review]

Watson, D. H.; Lindsay, D. G.

Journal of the Science of Food and Agriculture 33 (1) 59-67 (1982) [78 ref. En] [Food Sci. Div., Min. of Agric., Fisheries & Food, Great Westminster House,

Horseferry Road, London SW1P 2AE, UK]

Many biological assays (bioassays) have been developed to detect fungal toxins (mycotoxins). Few of these assays are as sensitive to mycotoxins as chemical assays or have been shown to be able to detect a wide range of different mycotoxins. Bioassays also suffer from a number of other problems including interference by non-fungal agents and from often being slow and less reproducible than chemical assays for mycotoxins. Bioassays have given little valuable information in their use in the surveillance of food and foodstuffs. Their major value has been in the initial identification and isolation of mycotoxins. AS

54

Occurrence, formation and detoxification of patulin mycotoxin.

Lindroth, S.

Publication, Technical Research Centre of Finland, Materials and Processing Technology No. 24, 46pp. (1980) [179 ref. En] [Food Res. Lab., Tech. Res. Cent., SF-02150 Espoo 15, Finland]

Production of patulin (particularly by the mould *Penicillium expansum*) is reviewed. The chemical and physical properties together with its possible pathogenic properties are investigated. Many bacterial spp. e.g. *Escherichia coli* and *Staphylococcus aureus* are inhibited; it has long been regarded as a carcinogen although this has not been proved conclusively. The LD₅₀ for mice is about 25 mg patulin/kg body wt. and 125 mg/kg is always lethal. Patulin producing groups are ubiquitous and are extremely likely to infect apples (data of occurrence on apples and other berries are given for Finland); patulin incidence is higher in home made jam than in commercial fruit products, and patulin concn. could not be reduced by skimming off the surface mould layer of jams. Fruit products e.g. blackcurrant, blueberry and strawberry jams could be improved by storage at 4°C with a 10% CO₂ atmosphere or by lowering the a_w level by adding sucrose, but this did not ensure prevention nor could this be ensured by normal cooking procedures; a better method is to sort all products before processing to eliminate fungus infection. Optimum growth conditions are a temp. of 25°C and pH 3–6.5. Patulin forms adducts with cysteine and other proteins which greatly reduce its toxicity, which could be significant in meat and cheese. Methods of determination by TLC, GLC HPLC and MS methods are discussed in detail. ELC

55

[Food hygiene and imported foodstuffs – with particular reference to mycotoxins.]

Udagawa, S.

New Food Industry [Nyu Fudo Indasutori] 23 (3) 16–18 (1981) [Ja] [Microbiol. Sect., National Hygiene Lab., Tokyo, Japan]

Between 1968 and 1977, the proportion of foodstuffs imported into Japan that were subjected to inspection annually varied between 4 and 10%. After an increase in the proportion of inspections in 1974 the rate has continued to decline in the face of a steeply rising volume of imports. Specific dangers from mycotoxin (particularly aflatoxin) contamination of foodstuffs from various parts of the world, are considered; a tighter inspection system is proposed. CIH

56

Mycotoxins in cereal grain. III. Production of ochratoxin A in different varieties of wheat, rye and barley.

Chelkowski, J.; Dopierala, G.; Godlewska, B.; Radomyska, W.; Szebiotko, K.

Nahrung 25 (7) 625–629 (1981) [10 ref. En, de, ru] [Agric. Univ., Inst. of Food Tech. of Plant Origin Commodities, Poznan, Poland]

Samples of disinfected cereal kernels (wheat, rye,

barley) were contaminated with spores of *Aspergillus ochraceus*. After 4 wk incubation at 15°C the ochratoxin A content of the samples was determined. Var. differed in resistance to mould growth and ochratoxin A formation. Zn was shown to be a limiting factor in toxin synthesis. Generally, healthy kernels capable of germination had high mould resistance; kernels incapable of germination (e.g. autoclaved) had low mould resistance. Selection of cereal varieties with high mould resistance and satisfactory transport and storage conditions are recommended to reduce mycotoxin formation and losses due to moulds. [See FSTA (1982) 14 3M391 for part II.] IN

57

Mycotoxins in cereal grain. IV. Inactivation of ochratoxin A and other mycotoxins during ammoniation.

Chelkowski, J.; Golinski, P.; Godlewska, B.; Radomyska W.; Szebiotko, K.; Wiewiorowska, M.

Nahrung 25 (7) 631–637 (1981) [6 ref. En, de, ru] [Agric. Univ., Inst. of Food Tech. of Plant Origin Commodities, Poznan, Poland]

Cereal kernels (corn, barley, wheat) contaminated with ochratoxin A were treated with NH₃ at 20–50°C, the kernels being in ground or whole form. A final ammonia concn. of 2% was sufficient to inactivate ochratoxin A, citrinin and penicillic acid, and partially inactivate zearalenone. Chickens fed NH₃ treated grain or untreated grain had no symptoms of poisoning. [See preceding abstr. for part III.] IN

58

Colorimetric determination of patulin produced by *Penicillium patulum*.

Thirugnana Subramanian

Journal of the Association of Official Analytical Chemists 65 (1) 5–7 (1982) [14 ref. En] [Dep. of Biochem., Univ. of Madras, Guindy Campus, Madras-600025, India]

A method for detn. of patulin in foods is described, in which patulin is extracted with diethyl ether, the extract is evaporated to dryness under vacuum, patulin is re-extracted into ethanol, and separated by TLC on silica gel G (development with toluene/ethyl acetate/formic acid (50:40:10)). The developed plate is sprayed with phenylhydrazine hydrochloride solution; yellow spots are scraped off the chromatogram, patulin phenylhydrazone is extracted with n-butyl alcohol and determined by colorimetry at 540 nm. Recoveries from bread and rice samples (spiked with ≤ 500 µg patulin/100 g) were 70–91% and 85–98% resp. Detection limit is 1 µg/g. *Penicillium patulum* inoculated on bread and on rice formed 1.1 and 0.9 µg patulin/100 g resp. AJDW

59

Walter A. Pons, Jr. memorial symposium on mycotoxins presented at the 72nd annual meeting of the American Oil Chemists' Society held in New Orleans, Louisiana, Fairmont Hotel, May 19–20, 1981 [Conference proceedings] United States of America, American Oil Chemists' Society

Journal of the American Oil Chemists' Society 58 (12) 927A-1022A (1981) [many ref. En]

This symposium contains papers on: Replacement of benzene as a solvent for aflatoxin standards, by J. Velasco (pp. 938A-940A, 2 ref.). Isolation of alternariol and alternariols I and II, minor mycotoxins elaborated by *Alternaria*, by F. S. Chu (pp. 1006A-1008A, 6 ref.). A further 15 papers are abstracted separately and can be found in the author index under United States of America, American Oil Chemists' Society [Mycotoxins Symposium]. LH

60

Minicolumn chromatography: state of the art.

[Lecture]

Holaday, C. E.

Journal of the American Oil Chemists' Society 58 (12) 931A-934A (1981) [15 ref. En] [Nat. Peanut Res. Lab., USDA, S.E. Area, PO Box 637, Dawson, Georgia 31742, USA]

The state of the art of minicolumn (MC) chromatography, as related to mycotoxin detn., is surveyed under headings of: development of the minicolumn method for aflatoxin, development of a combined MC procedure for aflatoxin and ochratoxin A, development of an MC method for zearalenone, development of an MC method for aflatoxin M, potential of the MC chromatography technique. [See FSTA (1982) 14 7B96.] LH

61

Production of alternariol and alternariol methyl ether by *Alternaria* spp.

Maas, M. R.; Woody, M. A.; Chu, F. S.

Journal of Food Safety 3 (1) 39-47 (1980) [10 ref. En] [Dep. of Food Microbiol. & Toxicology, Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

5 isolates of *Alternaria alternata*, 5 of *A. tenuis*, 1 of *A. hemicota* and 3 of unidentified *Alternaria* spp. all of which produce toxins if they contaminate foods, were examined for their production of alternariol methyl ether (AME) and alternariol (AOH) in complex liquid media. The data were compared with the production of these 2 toxins on solid substrate rice cultures. A new HPLC method with min. detection levels for AME and AOH of 20 and 40 ng, resp., was used to measure the toxins. All isolates produced AME and AOH, but the amount varied considerably with the isolates and media tested. Of the 3 different liquid media tested, the highest quantity of AME and AOH was produced in a modified Czapek-Dox broth. The highest yield of toxins was obtained in the solid rice cultures. As much as 125 mg of AME and 16 mg of AOH were produced by one *A. tenuis* isolate on 300 g of rice after 14 days incubation at 25°C in darkness. AS

62

Enzyme-linked immunosorbent assay for T-2 toxin.

[Lecture]

Pestka, J. J.; Lee, S. C.; Lau, H. P.; Chu, F. S.

Journal of the American Oil Chemists' Society 58 (12) 940A-944A (1981) [20 ref. En] [Food Res. Inst., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

An enzyme-linked immunosorbent assay (ELISA) was developed for the rapid quantitation of T-2 toxin (found in several agricultural commodities used for food), a tricothecene mycotoxin produced by members of the genus *Fusarium*. T-2 toxin was first converted to the T-2 hemisuccinate (T-2 HS) and then conjugated by the water-soluble carbodiimide method to either bovine serum albumin for use as an immunogen or to horseradish peroxidase for use as an enzyme marker. T-2 antiserum was air-dried onto polystyrene microtissue culture plates and the ELISA conducted by simultaneously incubating standards of T-2 toxin and the T-2 HS-peroxidase conjugate. Competition curves were prepared by determining total bound enzyme. The ELISA took about 2 h to complete and allowed min. detection of T-2 levels of 2.5 pg/assay. Average recoveries from samples of wheat flour spiked with T-2 toxin in the 1.0-30 parts/billion range were $95 \pm 25\%$ and those for corn meal spiked in the 5.0-30 parts/billion range were $98 \pm 19\%$. The results suggested the ELISA is a simple and convenient alternative for the screening of T-2 toxin in food and feeds. [See FSTA (1982) 14 7B96.] AS

63

[Methods of mycotoxin analysis in foods.] [Review]

Jemmali, M.

Oleagineux 35 (7) 357-364 (1980) [33 ref. Fr, en, es] [INSERM, 16 Rue Nicolas-Fortin, 75013 Paris, France]

This review discusses: criteria for selecting official methods of mycotoxin analysis; mycotoxin research and detn.; detn. of conjugated mycotoxins; factors affecting the results and precautions necessary for accurate analysis; and legislation. Special attention is given to sampling methods. Extraction, purification, separation, identification, detection and detn. methods are briefly described. RM

64

Development of a method for the analysis of T-2 toxin in maize by gas chromatography-mass spectrometry.

Chaytor, J. P.; Saxby, M. J.

Journal of Chromatography 237 (1) 107-113 (1982) [12 ref. En] [Leatherhead Food RA, Randalls Road, Leatherhead, Surrey KT22 7RY, UK]

A ground sample is homogenized with ethyl acetate, the mixture filtered, and the extract recovered by evaporation of the solvent. The residue is defatted by partition between aqueous methanol and hexane. The aqueous phase is evaporated to dryness and the residue dissolved in dichloromethane and passed through a cartridge of silica. T-2 toxin is eluted with methanol/dichloromethane, the solvents removed and the residue silylated. O-Trimethylsilyl T-2 toxin is detected by gas chromatography MS with monitoring of the ions at m/z 350 and m/z 436. The quantitative detection limit is 5 µg/kg with an average recovery of 80%. AS

65

The pharmacokinetic profiles of ochratoxin A in pigs, rabbits and chickens.

Galtier, P.; Alvinerie, M.; Charpentreau, J. L.
Food and Cosmetics Toxicology 19 (6) 735-738 (1981)
[18 ref. En][Lab. de Pharmacologie-Toxicol., INRA,
180 Chemin de Tournefeuille, 31300 Toulouse, France]

Investigations were carried out to determine the fate of ochratoxin A in the plasma after oral and intravenous administration in animals kept for meat: pigs, rabbits and chickens. Ochratoxin A was administered at dose levels of 0.5, 2 and 2 mg/kg body wt., resp. Conc. of the ochratoxin in the plasma were measured for ≤ 120 h following treatment. 65.7, 55.6 and 40.0% of the administered dose was absorbed by pigs, rabbits, and chickens resp. On the basis of pharmacokinetic data obtained in this study the problem of residues can be predicted as follows. There will be a problem in rabbits and chickens due to the wide distribution of ochratoxin A in the organism. In pigs the hazard will arise because of the persistence of residues. VJG

66

[Determination of patulin in apple products by high performance liquid chromatography.] Bestimmung von Patulin in Apfelerzeugnissen mit Hochleistungs-Flüssigkeits-Chromatographie.

Geipel, M.; Baltes, W.; Krönert, W.; Weber, R.
Chemie Mikrobiologie Technologie der Lebensmittel 7 (3) 93-96 (1981) [22 ref. De, en][TU Berlin Inst. für Lebensmittelchemie, Strasse des 17. Juni 135, 1000 Berlin 12]

A reversed phase HPLC method is described for detn. of patulin in apple products. 74 different commercial products (105 samples), namely juices, juice-based beverages, jellies, baby food, mixed-fruit beverages, were analysed. In most of them (93%) the content of this mycotoxin was $< 10 \mu\text{g/kg}$. Only 1 product (apple juice) from 1 specific producer was contaminated with higher rates of patulin (up to $42 \mu\text{g/kg}$). AS

67

[Patulin in fruit juices: methods of analysis.] Vilbois, F.

Bios 12 (5) 26-27 (1981) [6 ref. Fr][IFBM, 1 Rue Grandville, BP 576, 54009 Nancy Cedex, France]

Methods for analysis of patulin in fruit juice are briefly reviewed, with some details given of the following: an extraction method based on use of ethyl acetate; 2 HPLC methods, 1 using a μ Porasil column eluting with diisopropyl ether/dichloromethane (95/5) + 0.1% acetic acid and the other using a Spherosil XOA 600 column, eluting with heptane/dichloromethane/methanol (80/15/3) in both cases using UV absorption for detection; and a TLC method using silica gel plates with developments (in the same direction) with pentane/ethyl acetate (96/4) followed by diisopropyl ether/pentane/ethanol/pyridine (84/12/4/0.8). It is concluded that the described methods could be improved in a number of ways, and that the most promising improvement would probably be the use of reversed phase HPLC. DIH

68

Mycotoxins and the cereals industry - a review.

[Review]

Osborne, B. G.

Journal of Food Technology 17 (1) 1-9 (1982) [36 ref. En][Flour Milling & Baking Res. Assoc., Chorleywood, Herts, WD3 5SH, UK]

Mycotoxins which have been detected in cereals are aflatoxins, zearalenone, ochratoxin A, nivalenol, deoxynivalenol, T-2 toxin and diacetoxyscirpenol and of these only aflatoxin B₁ has so far been shown to exhibit serious toxicity to humans. Surveys have shown that the occurrence of mycotoxins in cereals in the UK and USA is rare except for localized problems with corn in the Southern USA. Also it is clear that aflatoxins are more likely to occur in warm humid climates while the other mycotoxins listed above are more characteristic of temperate climates if there is a wet harvest. AS

69

Natural occurrence of moniliformin together with deoxynivalenol and zearalenone in Transkeian corn. Thiel, P. G.; Meyer, C. J.; Marasas, W. F. O.

Journal of Agricultural and Food Chemistry 30 (2) 308-312 (1982) [24 ref. En][Nat. Res. Inst. for Nutr. Diseases, S. African Med. Res. Council, Tygerberg 7505, South Africa]

Mycotoxicological investigations were carried out on a sample of mouldy corn from Butterworth, Transkei, a district with a very high human oesophageal cancer rate. Three spp. of *Fusarium*, i.e. *F. graminearum*, *F. sacchari* var. *subglutinans* (= *F. moniliforme* var. *subglutinans*), and *F. verticillioides* (= *F. moniliforme*), were isolated from the mouldy corn kernels. Three *Fusarium* mycotoxins, i.e., moniliformin, deoxynivalenol, and zearalenone, were detected in the original sample of mouldy kernels and at higher levels in a hand-selected subsample of visibly *Fusarium* infected kernels. This is the first indication of the natural occurrence of moniliformin. In culture, moniliformin was produced by

isolates of *F. sacchari* var. *subglutinans* from the mouldy corn, zearalenone by isolates of *F. graminearum*, and deoxynivalenol by an isolate of *F. graminearum*. Two isolates of *F. verticillioides* did not produce any of these 3 mycotoxins in culture. AS

70

[Occurrence of zearalenone in Czechoslovak cereals.]

Bartos, J.; Matyas, Z.

Veterinarni Medicina 26 (8) 505-512 (1981) [24 ref. Cs, ru, en, de][Vyzkumny Ustav Vet. Lekarstvi, 62132 Brno, Czechoslovakia]

15 samples of (i) maize, 28 of (ii) wheat, 12 of (iii) barley, and 5 of (iv) oats of the 1980 harvest, mainly from Moravia, and some from Slovakia and Bohemia were examined for zearalenone by the method of Mirocha et al. [FSTA (1975) 7 2M140]. The compound was detected in 1 sample (6.7%) of (i) at $0.33 \mu\text{mol/kg}$, in 13 (46.4%) of (ii) at $0.19-0.57 \mu\text{mol/kg}$, in 7 (58.3%) of (iii) at $0.19-0.82 \mu\text{mol/kg}$, and in none of (iv). The method used is recommended for screening of Czechoslovak cereals. SKK

71

Vomitoxin: natural occurrence on cereal grains and significance as a refusal and emetic factor to swine. [Review]

Vesonder, R. F.; Hesseltine, C. W.

Process Biochemistry 16 (1) 12-15, 44 (1980/1981) [48 ref. En] [Fermentation Lab., USDA, Peoria, Illinois 61604, USA]

The natural occurrence of vomitoxin is reviewed under the headings: history of refusal and emetic factors in scabbed grains; classification of *Fusaria* involved in fusariotoxicoeses; physicochemical properties of vomitoxin; natural occurrence of vomitoxin and trichothecenes; analysis of vomitoxin, using quantitative methods such as GLC and gas chromatography-MS and TLC; and economics of vomitoxin. SP

72

[Recent developments in milk production and occurrence of pathogens in milk and dairy products.] Neuzeitliche Entwicklungen im Bereich der Milchwirtschaft und das Vorkommen von Erregern in Milch und Milchprodukten. [Review]

Lang, K.

Öffentliche Gesundheitswesen 40 (3) 131-139 (1978) [38 ref. De, en] [Justus Liebig Univ., Giessen, Federal Republic of Germany]

After reviewing the potential of milk and milk products as a carrier of pathogenic microorganisms and a source of human infection, the author outlines measures taken in the Federal Republic of Germany since the 2nd World War in the form of legislation to prevent such contamination. Possible dangers of post-processing contamination of milk and milk products with pathogens and the possible occurrence of mycotoxins in pasteurized milk and cheese is also discussed. EJM

73

[Mycotoxins in mould-ripened cheese: a review.]

Mykotoxine in schimmelgereiften Käsen - eine Literaturübersicht. [Review]

Schoch, U.

Mitteilungen aus dem Gebiete der Lebensmitteluntersuchung und Hygiene 72 (4) 380-395 (1981) [61 ref. De, en, fr] [Inst. für Toxikologie der ETH, Zurich, Switzerland]

An outline is given of the types of moulds used for cheesemaking (e.g. *Penicillium roqueforti* and *P. camemberti*), and the biosynthesis of mycotoxins (cyclopiazonic acid, PR-toxin, roquefortine, mycophenolic acid, isofumigaclavins A & B and penicillic acid) by *Penicillium* spp. is discussed. Factors influencing the formation of mycotoxins, biological properties of mycotoxins and their occurrence in cheese are also discussed. MEG

74

Toxic 12,13-epoxytrichothecenes from anise fruits infected with *Trichothecium roseum*.

Ghosal, S.; Chakrabarti, D. K.; Srivastava, A. K.; Srivastava, R. S.

Journal of Agricultural and Food Chemistry 30 (1) 106-109 (1982) [17 ref. En] [Pharmaceutical Chem. Res. Lab., Dep. of Pharmaceutics, Banaras Hindu Univ., Varanasi-5, India]

Four 12,13-epoxytrichothecenes, viz., (i) 4-*O*-acetyltrichothecolone, (ii) 4-*O*-cinnamoyltrichothecolone, (iii) trichothecolone and (iv) trichothecin, were isolated and characterized from anise fruits infected in fields with *T. roseum* van Beyma (CMI-IMI 225229). Among these compounds, (i) and (ii) are naturally occurring new 12,13-epoxytrichothecenes. From the in vitro culture extracts of the fungus, only (i), (iii) and (iv) were isolated and identified. Thus, the host-parasite interaction was suggested for the formation of (ii), its cinnamoyl moiety being a metabolite of the host species. The total chloroform extractives of the mouldy anise fruits produced dermatitic skin reactions in albino rats on external application and caused listlessness, anorexia, diarrhoea, and stunted growth when ingested. The circumstantial evidence suggests toxin risk in man from prolonged ingestion of mouldy anise fruits. AS

75

[Recent developments of mycotoxin-monitoring system.] [Review]

Ueno, Y.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 21 (5) 339-343 (1980) [20 ref. Ja] [Fac. of Pharmacy, Tokyo Univ. Sci., Ichigaya Funagawara-machi, Shinjuku-ku, Tokyo, Japan]

The monitoring systems for mycotoxins mutagenetic to *Salmonella typhimurium*, metabolic products such as aflatoxin B₁, and radioimmunoassay for mycotoxins in trace quantities were reviewed. Fluorescence analysis, supply of standard mycotoxin and related problems are discussed. TM

76

Mycotoxin teratogenicity and mutagenicity. [Book]

Hayes, A. W.

121pp. ISBN 0-8493-5651-2 (1981) [673 ref. En] [Boca Raton, Florida, USA; CRC Press, Inc. [Rohm & Haas Co., Spring House, Pennsylvania, USA]

This book brings together the available published data on mycotoxins and their potential mutagenicity and teratogenicity in animals and in man. The format of the text is in 4 parts. The first chapter (pp. 1-10) is a general introduction which deals with the overall problem of mutagenicity and teratogenicity to the human population. The second chapter (pp. 11-40) presents the available evidence suggesting the involvement of mycotoxins in human diseases (ergotism, cardiac beriberi, alimentary toxic aleukia, stachybotryotoxicosis, drunken bread, dendrodotoxicum, aflatoxin diseases, balkan nephropathy, kashin-beck, onyalai) and the use of experimental animals to test for carcinogenicity, teratogenicity, target organ injury, and cellular toxicity.

The third chapter (pp. 41–66) deals with mycotoxins (including aflatoxins *Aspergillus* mycotoxins, *Penicillium* mycotoxins, mycotoxins of both *Penicillium* and *Aspergillus* spp., *Alternaria* toxins, cytochalasins, ergot alkaloids, *Stachybotrys* toxins, *Fusarium* toxins, Streptozotocin) and abnormal foetal development. The fourth chapter (pp. 67–90) considers mycotoxins as mutagens. A bibliography of 673 references is appended. VJG

77

Mycotoxins in food.

Martin, C. R. A.

British Food Journal 83 (903) 102–103, 116 (1981) [6 ref. En]

The range of mycotoxicoses associated with food is surveyed, including ergotism, and toxins from *Aspergillus*, *Penicillium*, *Fusarium*, and other genera. In general, it is concluded, no real hazard to human health is posed by mycotoxins, and toxic symptoms are only found when mouldy foods are eaten in high doses for prolonged periods; however, the modern recovery technologies and the increasing use of novel sources of human food pose new problems, and contamination with mycotoxins should always be considered. JRR

78

[Biosynthesis of mycotoxins by the *Aspergillus* and *Penicillium* fungi isolated from grain.]

L'vova, L. S.; Shul'gina, A. P.; Shatilova, T. I.; Kizlenko, O. I.

Prikladnaya Biokhimiya i Mikrobiologiya 14 (5) 735–741 (1978) [23 ref. Ru, en] [Vses. Nauchno-issled. Inst. Zerna i Produktov ego Pererabotki, Moscow, USSR]

79

[Ochratoxin, contamination of feed and porcine nephropathy: limitation of the loss.]

Krogh, P.

Dansk Veterinaertidsskrift 62 (12) 617–625 (1979)

[29 ref. Da] [Dep. of Vet. Microbiol., Purdue Univ., W. Lafayette, Indiana 47907, USA]

Feeding ochratoxin-contaminated fodder to swine may result in development of nephropathy, with consequent condemnation of the carcass as unfit for human consumption. This problem is discussed with reference to: structure and characteristics of ochratoxin; conditions required for ochratoxin formation; climatic effects on ochratoxin formation and incidence of porcine nephropathy; the relation between levels of ochratoxin in feed and in tissues of swine; biological half-lives of ochratoxins in pig tissues; and potential methods for minimization of losses resulting from porcine nephropathy. AJDW

80

[Determination of ochratoxin.]

Funder-Schmidt, B.

Dansk Veterinaertidsskrift 62 (1) 18–20 (1979) [6 ref. Da] [Miljø- og Levnedsmiddelkontrollenheden, Kemisk Lab., Rugårdsvej 60, 5000 Odense C, Denmark]

After a discussion of the structure and physicochemical characteristics of ochratoxin A, detn. of ochratoxin A in porcine kidney tissue by a

modification of the AOAC method for detn. of ochratoxin in barley is described. The method is based on acidification of the sample with H_3PO_4 , extraction with chloroform, clean-up on a Celite 545 column (elution of ochratoxin with chloroform acidified with formic acid), elimination of the solvent by evaporation, and analysis by TLC on silica gel with a benzene/methanol/acetic mixture, with UV fluorescence detection. The detection limit is 7 µg/kg; the Danish tolerance for ochratoxin A in swine kidneys is 10 µg/kg. AJDW

81

[Determination of patulin in foods – proposal for a standard method.] Zur Bestimmung von Patulin in Lebensmitteln – Vorschlag einer Standardmethode.

Meyer, R. A.

Nahrung 26 (4) 337–342 (1982) [12 ref. De, en, ru]

[Bezirks-Hygieneinspektion & -inst. Dresden, German Democratic Republic]

A method for detn. of patulin in foods is described; patulin is extracted with ethyl acetate, the extract is conc. by evaporation, subjected to clean-up on a silica gel column (elution with ethyl acetate) and determined by TLC on silica gel with toluene/ethyl acetate/85% formic acid (50:40:10 v/v), with detn. using Cl_2/α -anisidine. A procedure for confirmation by TLC after acetylation with acetic anhydride is given. Detection limit is 20 µg/l; recovery is 80–100%. Data are given for patulin concn. in 609 samples of apple juice, from the period 1975–1980. 27% were free from patulin, 47% had 20–100 µg/l, 20% had 100–400 µg/l and 6% had > 400 µg/l. AJDW

82

[Chromatographic determination of the mycotoxin zearalenone in meat tissues and corn.]

Ermakov, V. V.; Kostyunina, N. A.

Voprosy Pitaniya No. 2, 19–22 (1981) [11 ref. Ru] [Vses. Nauchno-issled. Inst. Vet. Sanitarii, Moscow, USSR]

The thermostability of the mycotoxin zearalenone [ZE] and its occurrence in corn can lead to its occurrence in flour products and meat (via animal fodder). TLC (i) and spectrofluorimetry (ii) methods are fully described for determining ZE in corn and meat samples (muscle, internal organs). Detection levels (using the 2 methods) are tabulated for meat samples – either spiked with 1–20 µg/10 g sample or taken from animals indirectly fed ZE [via the fodder]. Detection levels for ZE concn. of 250–1000 µg/kg were 50–95% with a standard error of 20–30% for (i), and 76.2–85.8% with a 5.2–8.6% standard error for (ii). RAW

83

[The mycotoxin and especially the aflatoxin situation in beer, raw materials and by-products of brewing.]

Zur Mykotoxin- und insbesondere zur Aflatoxinsituation bei Bier, Ausgangsstoffen und Nebenprodukten der Bierbereitung.

Woller, R.; Majerus, P.

Brauwissenschaft 35 (4) 88–90 (1982) [12 ref. De, en, fr]

[Staatliches Chem. Untersuchungsamt Trier, Maximineracht 110, D-5000 Trier, Federal Republic of Germany]

Literature data on occurrence of mycotoxins in beer and in brewery raw materials and by-products are briefly discussed. A total of 86 samples of beer, 23 of malt, 16 of hops and hop preparations, 11 of spent malt or hops, and 38 of yeast or yeast extract were analysed for aflatoxins; none of the samples studied contained aflatoxins. AJDW

84

Investigations of contaminants in coffee. (In '9th International Scientific Colloquium on Coffee' [see FSTA (1982) 14 11H1751]) [Lecture]

Levi, C. P.

pp. 125-133 (1980) [35 ref. En] [General Foods Tech. Cent., Tarrytown, New York, USA]

In the first part of this paper a review of studies on analysis of benzo(a)pyrene (BaP) in coffee production is presented, followed by an investigation into BaP in (i) roasted and ground (13 samples), and (ii) soluble (20 samples) coffee. The analytical method chosen involved liquid-liquid partition, followed by HPLC with fluorescence detection. Levels of BaP were 5-30 µg/kg in 8 samples of (i) vs. 1-7 µg/kg in 9 of (ii), with remaining samples containing below detectable levels (< 1 µg/kg). In the second part, data is compiled from various studies into mycotoxins, i.e. aflatoxin, ochratoxin and sterigmatocystin, in damaged or

commercial green coffees. Numerous tables illustrate literature values of BaP in coffee, various grains and vegetable oils, and prepared food products, and give results of experimental studies. LH

85

Production of ochratoxin A in barley by *Aspergillus ochraceus* and *Penicillium viridicatum*: effect of fungal growth, time, temperature, and inoculum size. Hågblom, P.

Applied and Environmental Microbiology 43 (5) 1205-1207 (1982) [10 ref. En] [Inst. of Physiol. Bot., Univ. of Uppsala, S-751 21 Uppsala, Sweden]

86

Feeding experiments with ochratoxin A contaminated barley for bacon pigs. I. Influence on pig performance and residues.

Madsen, A.; Mortensen, H. P.; Hald, B.

Acta Agriculturae Scandinavica 32 (2) 225-239 (1982) [32 ref. En] [Dep. for Exp. with Pigs & Horses, Nat. Inst. of Anim. Sci., Rolighedsvej 25, 1958 Copenhagen V, Denmark]

Pigs were bought from specific pathogen free herds at approx. 8 wk of age, weighing 14-18 kg and given various experimental diets. Diets were 73.5% barley, 24.0% soybean meal and 2.5% minerals + vitamins at grower (20-50 kg) stage, followed by 85.4, 12.0 and 2.6% correspondingly at finisher (50-90 kg) stage. Various ochratoxin A (OA)-contaminated barley batches, all known to have caused poor pig performance were used, containing up to 2300 µg OA/kg. Some batches were detoxified by several methods. The contaminated barley was used to replace all or some of the non-contaminated barley in grower/finisher diets. After slaughter at 90 kg samples of blood, kidney, liver, *longissimus dorsi*, *psoas major*

and leaf fat were collected for residue analysis.

Naturally contaminated feed apparently had no direct influence on carcass quality. OA residues were greatest in kidney, and in declining order in lean meat, liver and fat. Content of OA increased with increasing levels in the feed, especially when OA was included in diets of 70-90 kg stages, i.e. immediately preslaughter. LH

87

The inhibitory effects of selected herbs, spices, and other plant materials on mycotoxigenic molds.

Azzouz, M. A.

Dissertation Abstracts International, B 42 (3) 955: Order no. 8118152, 153pp. (1981) [En] [Univ. of Nebraska, Lincoln, Nebraska 68503, USA]

This study examined the effects of 16 herbs and spices, 3 commercial chemical antifungal agents, and 9 other food materials on the growth and mycotoxin production of several mycotoxigenic moulds. Attempts were also made to identify the antifungal agent in white mustard which inhibits aflatoxin-producing *Aspergillus flavus*. Cloves, cinnamon, mustard, allspice, garlic and oregano at the 2% level completely inhibited the growth of all moulds studied. Powdered pomegranate peel at the 2% level was a good inhibitor of the 4 *Penicillium* strains tested. Of the 3 chemical agents potassium sorbate at the 0.3% level was most effective followed by sodium benzoate and calcium propionate. An antibiotic, pimarin, at the 5 p.p.m. level inhibited all moulds tested. The remaining spices and materials were either non-inhibitory or showed only slight inhibition. Combinations of low levels of potassium sorbate and cloves had a synergistic effect against mould growth. The 6 herbs and spices which completely inhibited mould growth also inhibited mycotoxin production. The antifungal agent in white mustard was identified as allyl isothiocyanate. JA

88

Optimization of fermentation parameters for kojic acid fermentation.

Bajpai, P.; Agrawal, P. K.; Viswanathan, L.

Indian Journal of Microbiology 21 (1) 42-51 (1981) [20 ref. En] [Biochem. Div., Nat. Sugar Inst., Kanpur-208 017, India]

20 strains of *Aspergillus flavus*, isolated from air and garden soils at Kanpur were screened for their ability to produce kojic acid (a precursor of a flavour enhancer) on a 20% sucrose and 2% yeast extract medium. The amount of kojic acid produced by different strains ranged from 24.2 to 75.6 mg/ml. The optimum conditions for kojic fermentation by static cultures of *A. flavus* were determined. These were a 20% sucrose/2% yeast extract medium, pH 6.5, temp. 30°C, and inoculum size of 5×10^6 spores/50 ml medium. Replacement of yeast extract by other crude extracts in a 20% sucrose and 2% yeast extract medium reduced growth and kojic acid production. Supplementation with aspartic acid, cystine, glycine, ascorbic acid, folic acid and pyridoxine stimulated, and supplementation with thiamin, riboflavin and panthothenic acid inhibited growth and kojic acid accumulation. A close correlation was observed between mycelial growth and kojic acid production. CFTRI

89

Botryodiplodin, a mycotoxin synthesized by a strain of *P. roqueforti*.

Moreau, S.; Lablache-Combier, A.; Biguet, J.; Foulon, C.; Delfosse, M.

Journal of Organic Chemistry 47 (12) 2358-2359 (1982) [12 ref. En] [INSERM, U-42, 59650 Villeneuve d'Ascq, France]

The toxic strain *Penicillium roqueforti* B-26 synthesized botryodiplodin, a mycotoxin previously isolated from *Botryodiplodia theobromae*. Its chemical structure and stereochemistry (obtained by X-ray analysis) are reported. AS

90

[Microflora and mycotoxins during ambient air drying of corn grain.] Mikroflora und Mykotoxine bei der Belüftungstrocknung von Körnermais.

Müller, H.-M.; Thaler, M.

Landwirtschaftliche Forschung, Sonderheft No. 37 (Kongressband 1980), 403-415 (1981) [many ref. De, en, fr] [Univ. Hohenheim, D-7000 Stuttgart 70, Federal Republic of Germany]

Corn grain stored in a bin was ventilated with ambient air from below until a moisture content of 12-13% was reached. During the drying of freshly harvested corn (initial moisture content: 39%) the viable counts of moulds, yeasts, aerobic mesophilic bacteria and the ergosterol content increased at heights of 30 to 130 cm above floor level. If conidia of *Fusarium graminearum*, *Penicillium expansum* and some other mycotoxin-producing moulds were inoculated before the beginning of ventilation, the mycotoxins zearalenone and patulin were produced. If the moisture content of freshly harvested corn was lowered to 19-27% by drying at high temp. (200°C air temp., grain temp. 90-110°C) and then to 12-13% by ambient air drying, the viable counts of mould, yeasts, bacteria and the ergosterol content did not increase during ambient air drying at a height up to 90 cm above floor level. However, the mould and yeast counts and the ergosterol content increased at heights between 90 and 150 cm. This increase was greater if moulds isolated from dried kernels were inoculated before ambient air drying. There was a significant increase of the viable count of *Penicillium verrucosum* var. *cyclopium* and some other moulds. None of the mycotoxins aflatoxin B₁, B₂, G₁, G₂, kojic acid, ochratoxin A, sterigmatocystin, citrinin, penicillic acid, patulin, zearalenone, diacetoxyscirpenol and T-2 toxin were detected after ambient air drying of pre-dried corn, whether inoculated with moulds before ventilation or not, i.e. high moisture corn can be preserved by combined pre-drying and ambient air drying up to a height of 90 cm above floor level. AS

91

[Determination of zearalenone in corn and mixed feedstuffs - collaborative study.] Bestimmung von Zearalenon in Mais und Mischfuttermitteln. Ergebnisse einer Ringanalyse.

Thaler, M.

Landwirtschaftliche Forschung, Sonderheft No. 37 (Kongressband Braunschweig 1980), 677-684 (1981) [20 ref. De, en, fr] [Univ. Hohenheim, 7000 Stuttgart 70, Federal Republic of Germany]

Zearalenone was determined in corn and mixed feedstuffs using the method of Mirocha et al. [see FSTA (1975) 7 2M140]. 4 corn samples were sent to 12 collaborators. 3 samples were spiked (0.08, 0.4 and 1.7 mg/kg) and 1 was naturally contaminated. Results from 9 collaborators were statistically analysed. All collaborators detected zearalenone in the sample containing 0.08 mg zearalenone/kg. Average recoveries for all samples were 97.5-88.4%, decreasing with increasing zearalenone content. The between-laboratory coeff. of variation were 53.9% at 0.08 mg/kg, 25.5% at 0.4 mg/kg, 20.3% at 1.7 mg/kg and 15.0% at 79.0 mg/kg. Similar tests were carried out for feed samples. [From En summ.] RM

92

Strain-specific synthesis of mycophenolic acid by *Penicillium roqueforti* in blue-veined cheese.

Engel, G.; Milczewski, K. E. von; Prokopek, D.; Teuber, M.

Applied and Environmental Microbiology 43 (5) 1034-1040 (1982) [16 ref. En] [Inst. of Microbiol., Fed. Dairy Res. Cent., D-2300 Kiel 1, Federal Republic of Germany]

20 of 80 strains of *Penicillium roqueforti* were able to produce up to 600 mg mycophenolic acid (MPA)/l in 2% yeast extract-5% sucrose broth. 62 of these strains had been isolated from the main blue-veined cheese var. of western Europe or from starter cultures. Of these 62 dairy strains, only 7 had MPA-producing potential in vitro. These 7 strains had all been isolated during the period 1975-1981 from the blue cheese of one individual factory. In cheese from the market, MPA (up to 5 mg/kg) was only found in samples from this same factory. MPA synthesis was only detected in cheese made with strains which form MPA in yeast extract-sucrose broth. Max. MPA content of 4 mg/kg was similar to that in commercial cheese. Toxicity of MPA was tested with 2 established human cell lines (Detroit 98 and Girardi Heart) and 1 established pig kidney cell line (AmII). AS

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FAB 50

MYCOTOXINS IN FOODS (EXCLUDING AFLATOXINS & MICROBIAL TOXINS)

SELECTED FROM VOLUME **13**

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of:-

Commonwealth Agricultural Bureaux, Farnham Royal, Slough; Gesellschaft für Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

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Coverage of the subject has been restricted to that of Food Science and Technology Abstracts, which covers over 1200 of the important food journals, patents from 20 countries and books published world-wide. Every effort is made to include all significant references, but editorial discretion is used on the many articles of borderline interest. If the reader particularly needs an exhaustive search of the subject, we will be pleased to provide any other references that we have available. We would, in any case, encourage readers to write or telephone us with any comments or queries that they may have.

H. BROOKES

EDITOR

[Mycotoxins and mycotoxicoses.] [Review]

Uboldi Eiroa, M. N.

Boletim do Instituto de Tecnologia de Alimentos, Brazil 16 (4) 355-411 (1979) [57 ref. Pt, en] [Inst. de Tecnologia de Alimentos, Campinas, Sao Paulo, Brazil]

Aspects considered in this review include: factors influencing growth and toxin formation by moulds in foods (a_w , pH, composition of the substrate, redox potential, temp., RH); the main mycotoxins (including aflatoxins, sterigmatocystin, luteoskyrin, rugulosin, ochratoxin, cyclopiazonic acid, rubratoxins, citrinin, gliotoxin, patulin, penicillic acid, sporidesmins, diploidiatoxins, citreoviridin, stachybotryotoxin, ergot, tremortin and kojic acid); microorganisms forming these toxins; symptoms of poisoning with these mycotoxins; epidemiological aspects; prevention of mycotoxicoses; detoxification of contaminated foods and feeds; analytical techniques; and tolerances for mycotoxins in foods. AJDW

2

[Identification of patulin in apple concentrates.]

Klepacka, M.; Konarska, K.

Zeszyty Naukowe Szkoły Głównej Gospodarstwa Wiejskiego Akademii Rolniczej w Warszawie, Technologia Rolno-Spozywcza No. 13, 31-41 (1979) [20 ref. Pl, ru, en]

Patulin was satisfactorily detected in a standard CHCl_3 solution of the crystalline product (0.2 mg/ml) using spectrophotometric, TLC and GLC methods. It was not detected, however, by any of these methods when added to an apple concentrate produced in 1976/1977 by CSO 'Hortex' (Poland). The failure is ascribed to conversion of patulin to other compounds when in contact with the concentrate. SKK

3

Terretonin, a toxic compound from *Aspergillus terreus*.

Springer, J. P.; Dorner, J. W.; Cole, R. J.; Cox, R. H. *Journal of Organic Chemistry* 44 (26) 4852-4854 (1979) [12 ref. En] [Merck Sharpe & Dohme Res. Lab., Rahway, New Jersey 07065, USA]

The isolation and structure detn. of terretonin, a new unique toxic metabolite of *A. terreus* is reported. The structural characterization included UV, IR, MS, circular dichroism, H-NMR, ^{13}C -NMR and X-ray analysis. AS

4

Effects of ochratoxin A on growth response and residues in broilers.

Prior, M. G.; O'Neil, J. B.; Sisodia, C. S.

Poultry Science 59 (6) 1254-1257 (1980) [14 ref. En] [Anim. Path. Div., Food Production & Inspection Branch, Agric. Canada, Saskatchewan Area Lab., Saskatoon, Saskatchewan, Canada S7N 2R3]

The effects of continuous feeding of graded levels (0.5, 1.0, 2.0 p.p.m.) of ochratoxin A (OA) for 8 wk to male and female broiler chickens were investigated. A depression in body wt. gain was observed in all groups receiving OA. The depression was proportional to the level of exposure to OA, and was more marked and prolonged in males than in females. Detectable residues

of OA were observed in the liver and kidney of birds fed 2 p.p.m. OA. Residues disappeared from liver within 24 h and from kidney within 48 h after withdrawal of the mycotoxin from feed. No residues of OA were found in muscle or fat. AS

5

[Occurrence of toxigenic moulds on cereals of varying provenance.] Zum Vorkommen toxinbildender Schimmelpilze in Cerealien unterschiedlicher Herkunft. [Lecture]

Bauer, J.; Gedek, B.

Landwirtschaftliche Forschung Sonderheft 35, 562-569 (1979) [24 ref. De, en, fr] [Univ. München, Veterinärstrasse 13, D-8000 Munich 22, Federal Republic of Germany]

307 mould strains of the genera *Aspergillus* (122) and *Penicillium* (185) were isolated from 107 cereal samples (81 maize, 17 wheat, 7 barley, 2 oats). After enrichment of their secondary metabolites in YES (yeast extract sucrose) medium the cultures were extracted with chloroform and examined for mycotoxins by TLC. 115 strains producing ≥ 1 of the following toxins were identified: penicillic acid, 63 strains (20.5%); kojic acid 41 (13.3%); cyclopiazonic acid 25 (8.1%); aflatoxins B_1 and B_2 15 strains each (4.9%); citreoviridin 3 (1%); luteoskyrin 3 (1%); citrinin 2 (0.6%); sterigmatocystin 2 (0.6%); ochratoxin A 1 (0.3%). Although both European and USA maize samples contained about 3 strains/sample, 44.3% of the strains isolated from USA maize were toxigenic, vs. 33.3% from European maize and 28.0% from all European cereals. *A. flavus* strains isolated from USA maize produced aflatoxins B_1 and B_2 , as well as cyclopiazonic acid, more frequently than strains from European samples. [See FSTA (1981) 13 1A3.] RM

6

Rapid screening method for zearalenone in corn, wheat and sorghum.

Holaday, C. E.

Journal of the American Oil Chemists' Society 57 (6) 491A-492A (1980) [18 ref. En] [Nat. Peanut Res. Lab., PO Box 637, Dawson, Georgia 31742, USA]

A rapid and sensitive (approx. 35 parts/billion) screening method has been developed for zearalenone in corn, wheat and sorghum. The method is based on minicolumn chromatography, and an analysis can be completed in approx. 10 min in most cases. Because several items used are disposable, the amount of wash up is reduced and the cost/detn. is maintained at a low level. AS

7

[Formation of kojic acid and aflatoxin by *Aspergillus flavus* in synthetic substrate and in grain maize.]

Bildung von Kojisäure und Aflatoxin durch *Aspergillus flavus* in synthetischem Substrat und in Körnermais. [Lecture]

Schröpfel, E.; Müller, H.-M.

Landwirtschaftliche Forschung Sonderheft 35, 570-585 (1979) [37 ref. De, en, fr] [Univ. Hohenheim, Postfach 106/06100, D-7000 Stuttgart 70, Federal Republic of Germany]

Spores of a strain of *A. flavus* that was toxigenic in synthetic medium were inoculated into corn at 38% moisture content (MC), pH 2, 4 or 9, and into corn silage, 32% MC, pH 4.5, and incubated at 20°C. Max. amounts of kojic acid and aflatoxin B₁ were produced at pH 2, max. aflatoxin B₂ at pH 9. No aflatoxin G₁ or G₂ was formed. Toxin formation was suppressed and mould growth greatly reduced by treating corn with propionic acid at the following concn: 0.3% for 18.1% MC corn, 0.53% for 24.3% MC, 0.75% for 32.5% MC, and 0.95% for 40.0% MC. [See FSTA (1981) 13 1A3.] RM

8

High-performance liquid chromatographic determination of major mycotoxins produced by *Alternaria* molds.

Heisler, E. G.; Siciliano, J.; Stinson, E. E.; Osman, S. F.; Bills, D. D.

Journal of Chromatography 194 (1) 89-94 (1980) [11 ref. En] [E. Reg. Res. Cent., Agric. Res., Sci. & Education Administration, USDA, Philadelphia, Pennsylvania 19118, USA]

In connection with the need for a rapid method for determining *Alternaria* mycotoxins in fruit and vegetables, HPLC was examined. The mycotoxins used in the studies were alternariol (AOH), alternariol monomethyl ether (AME), altenuene (ALT) and tenuazonic acid (TaA). Standard solutions of these 4 mycotoxins were separated by reversed-phase HPLC using a column packed with μ Bondapak C₁₈ (monomolecular layer of organosilane bonded to porous silica particles); the system was operated isocratically with 2 binary solvent systems consisting of methanol/water and acetone/water. the proportions of each solvent and water being varied over the range 9:1 to 6:4 (v/v) in order to determine the optimum proportions for separation of the mycotoxins. Detector wavelengths were 324 nm for AOH, ALT and AME and 278 nm for TaA; since acetone absorbs strongly at 278 nm, the acetone/water system was not suitable for separation of TaA. Chloroform extracts of fruit and vegetables (e.g. tomatoes, apples, blueberries) that were infected with *Alternaria* were also subjected to HPLC. Successful separation and quantitation of ALT, AOH and AME were achieved with the HPLC system using acetone/water (65:35, v/v) for elution, while for TaA successful results were obtained with methanol/water (9:1, v/v). The HPLC system was also successfully applied to the crude fruit and vegetable extracts. JA

9

Chromatographic analysis of mycotoxins on thin layers of rice starch.

Miskovic, D.

Chromatographia 13 (6) 342-344 (1980) [12 ref. En] [Fac. of Sci., Univ. of Novi Sad, 21000 Novi Sad, Yugoslavia]

The TLC separation and UV detection of 12 mycotoxins on rice starch is described, including the effect of solvent systems on the fluorescence, and the mechanism of chromatographic separation. R_f values of aflatoxins B₁, B₂, G₁, G₂, M₁ and M₂, zearalenone, zearalenol, ochratoxins A, B, B-ester and C, in 3 solvent

systems (0.15 ml of formic acid + 20 ml benzene, toluene or xylene) are tabulated, together with lower limits of visual detection (fluorescence at 254-366 μ m) (i.e. 10⁻³ μ g aflatoxins, 10⁻¹ μ g zearalenone and zearalenol, 10⁻³ μ g ochratoxins.) RM

10

Survey for zearalenone, aflatoxin, and ochratoxin in US grain sorghum from 1975 and 1976 crops.
Shotwell, O. L.; Bennett, G. A.; Goulden, M. L.; Plattner, R. D.; Hesseltine, C. W.

Journal of the Association of Official Analytical Chemists 63 (4) 922-926 (1980) [16 ref. En] [N. Reg. Res. Cent., USDA, Peoria, Illinois 61604, USA]

Grain sorghum samples (197) from 10 States harvested in 1975 and 1976 were analysed for zearalenone, aflatoxin, and ochratoxin by the Eppley procedure. Zearalenone was detected in 56 samples (28%) at levels of 200-6900 ng/g (the detection limit was 100-200 ng/g). Zearalenone identity was confirmed in representative samples by GLC-MS of the trimethylsilyl derivatives. No ochratoxin was detected in any sample (the detection limit was about 50 ng/g). Aflatoxin was detected in 4 samples at levels of 54, 6, 10, and 7 ng total aflatoxin/g (the detection limit was approx. 3 ng/g). The identity of aflatoxin B₁ in the samples was confirmed by formation of the water adduct on TLC plates. AS

11

Destruction of zearalenone in contaminated corn.

Bennett, G. A.; Shotwell, O. L.; Hesseltine, C. W.

Journal of the American Oil Chemists' Society 57 (8) 245-247 (1980) [13 ref. En] [N. Reg. Res. Cent., USDA, Peoria, Illinois 61604, USA]

Several chemical and physical treatments were investigated as possible methods for destroying zearalenone in contaminated corn. An ammoniation process which significantly lowers aflatoxin levels had no effect on zearalenone contamination in yellow corn. Also, treatments of propionic acid, acetic acid, HCl, sodium bicarbonate and H₂O₂ failed to reduce toxin levels. High-temp. treatment (150°C) had no effect on zearalenone. Formaldehyde, in vapour form from paraformaldehyde crystals or in aqueous solutions, destroyed significant quantities of zearalenone in naturally contaminated yellow corn meal and in spiked corn grits and animal feed. Samples treated with aqueous formaldehyde must be dried at $\geq 50^\circ\text{C}$ to cause effective destruction of zearalenone. Levels as high as 10 p.p.m. zearalenone in animal feed and 8 p.p.m. in ground corn were reduced to <0.5 p.p.m. with formaldehyde. Ammonium hydroxide and formaldehyde partially destroyed zearalenone in highly contaminated ground corn. Levels as high as 33.5 p.p.m. were reduced to 12 p.p.m. by 3% ammonium hydroxide and to 2.1 p.p.m. by 3.7% formaldehyde. No treatment used in this study significantly reduced zearalenone levels in whole-kernel corn. AS

Detection of rubratoxin B and seven other mycotoxins in corn.

Whidden, M. P.; Davis, N. D.; Diener, U. L.
Journal of Agricultural and Food Chemistry 28 (4)
784-786 (1980) [22 ref. En] [Botany, Plant Path. Dep.,
Auburn Univ. Agric. Exp. Sta., Auburn, Alabama 36830,
USA]

A method was developed for simultaneous extraction, separation, and qualitative analysis of rubratoxin B, aflatoxin B₁, diacetoxyscirpenol, ochratoxin A, patulin, penicillic acid, sterigmatocystin, and zearalenone in corn. Mycotoxins were extracted with acetonitrile, sequentially eluted from a silica gel minicolumn, and visualized by TLC methods. Rubratoxin B was quantitatively measured, using the TLC solvent system acetonitrile/acetic acid (100:2, v/v), with as little as 10 mg toxin/kg corn being detected. Extraction and total efficiencies for rubratoxin B were approx. 66 and 31%, resp. Three new confirmation tests for rubratoxin B are reported: NH₄OH vapour intensified the fluorescence of a heat-produced derivative of rubratoxin B; chlorine/pyrazolinone/cyanide reagent reacted with rubratoxin B to produce a pink spot that rapidly changed to blue, following exposure to heat and NH₄OH; and prolonged heating of rubratoxin B on TLC plates in the presence of NH₄HCO₃ also produced a blue fluorescent derivative. AS

13

[Mould cultures - a contribution to solution of the mycotoxin problem.]

Liepe, H.-U.

RTVA 18 (154) 48-49 (1979) [15 ref. Fr] [Rudolf Müller & Co., Giessen, Federal Republic of Germany]

Ripening of dry sausages by moulds is discussed, with special reference to the danger of mycotoxin formation by certain strains growing on sausages. The use of starter cultures of the non-toxic species *Penicillium nalgiovense* is discussed: practical aspects of the use of this culture are considered. Advantages claimed include: elimination of the mycotoxin hazard, with consequent improvement of export prospects; uniform product quality; improved colour and aroma of the sausage; prevention of growth of undesirable moulds; and minimization of the risk of excessive drying. Some cultures have considerable cellulase activity, and are therefore unsuitable for use with sausages in cellulose casings; selected starter cultures have low cellulase activity. AJDW

14

Application of column liquid chromatography (HPLC) to special problems in food chemistry.

A laboratory note. [Lecture]

Pechanek, V.; Blaicher, G.; Pfannhauser, W.; Woidich, H.

Chromatographia 13 (7) 421-427 (1980) [11 ref. En]
[Forschungsinst. der Ernährungswissenschaft,
Blaasstrasse 29, 1190 Vienna, Austria]

This survey gives a short account of the applications and design of the column liquid analyser, and HPLC conditions used in the authors' laboratory during the last 5 yr. Liquid chromatography was used for the detn.

of amino acids, sugars and biogenic amines in various foods. Special problems, e.g. detn. of patulin in apple juice, and hyoscyamine and scopolamine in canned French beans were also solved by HPLC. [From En summ.] [See FSTA (1981) 13 3A108.] RM

15

Analysis of the fusariotoxins Zearalenone and vomitoxin (deoxynivalenol) in human foods and animal feeds by high-performance liquid chromatography (HPLC). [Lecture]

Schweighardt, H.; Böhm, J.; Abdelhamid, A. M.; Leibetseder, J.; Schuh, M.; Glawischnig, E.
Chromatographia 13 (7) 447-450 (1980) [19 ref. En]
[Inst. für Ernährung, Vet. Med. Univ. Wien, Linke
Bahngasse 11, 1030 Vienna, Austria]

HPLC procedures for analyses of the fusariotoxins zearalenone and vomitoxin in individual foods and feedstuffs and in mixed feeds are described. Zearalenone is separated on a column with polar stationary phase, eluted with a chloroform-isooctane (75/25, v/v) + 1.5% methanol mixture and detected fluorometrically. Quantitative detn. was possible in all samples with a detection limit of 2 µg/kg, with 70-80% recovery. Vomitoxin is fractionated by HPLC with water-methanol (60/40, v/v) mobile phase, and determined by combining GLC or TLC with UV detection. The detection limit in mixed feed with interfering substances was 25 µg/kg (recovery 25-35%). HPLC separation allows preparation of pure vomitoxin. The methods described are fast, simple, cheap and suitable for routine analyses. [See FSTA (1981) 13 3A108.] AS

16

On the occurrence of mycotoxins (aflatoxins and zearalenone) in some foods and feeds, in Italy. (In 'Food microbiology and technology' [see FSTA (1981) 13 3B17].) [Lecture]

Bottalico, A.

pp. 337-346 (1979) [many ref. En, it] [Cent. di Studio del Consiglio Nazionale delle Ricerche su le Tossine, Istituto di Patologia Vegetale dell'Univ., Bari, Italy]

Investigations on the occurrence of aflatoxins, zearalenone and associated toxigenic fungi in foods and feeds imported to or produced in Italy, were carried out during the last 3 yr. Samples of finished commercial almonds, i.e. whole, peeled, sliced and diced almonds, almond meals and a few samples of some feedstuffs were analysed for aflatoxins. Traces or low concn. of aflatoxins were found in 3 samples of almond meals (about 5-10 µg/kg) and in some samples of maize (about 5-10 µg/kg), soybean meals (about 20 µg/kg), wheat, chick-pea and carob (about 20-50 µg/kg), whereas higher concn. were found in meals or oil-cakes of sunflower (from 20 to 100 µg/kg), flax (about 100 µg/kg) and peanut (about 200 µg/kg). Samples of commercial cereal grains or meals, and freshly harvested maize and wheat grains were analysed for zearalenone. The toxin was found in 3 samples of imported maize (from 0.4 to 2 mg/kg) and in a few samples of maize collected at harvest time (from traces to 0.24 mg/kg) or in maize grains taken from ears infected by *Fusarium graminearum* (≤ 42 mg/kg). Zearalenone production in vitro by 98 *Fusarium*

isolates, belonging to 9 spp., collected from cereals all over Italy was also assessed. The toxin was produced by *Fusarium graminearum*, *F. culmorum* and, to a much lesser extent, by *F. moniliforme*. AS

17

Effects of feeding T-2 toxin to rats and monkeys.

Rukmini, C.; Prasad, J. S.; Rao, K.

Food and Cosmetics Toxicology 18 (3) 267-269 (1980) [18 ref. En] [Nat. Inst. of Nutr., Indian Council of Med. Res., Hyderabad-500 007, India]

A diet containing mouldy sorghum (naturally contaminated with *Fusarium incarnatum*) that supplied 25 p.p.m. T-2 toxin/day was fed to rats for 16 wk. The toxin produced a marked growth depression and loss of body fur in the rats. As there were no reports of the effects of T-2 toxin in primates, a semi-purified T-2 toxin was administered to monkeys (1 or 0.5 mg/kg/day). Male monkeys were more susceptible to the toxin than female monkeys. At an oral dose equivalent to 0.1 mg pure T-2 toxin/kg body wt./day both male and female monkeys developed leucocytopenia and mild anaemia. VJG

18

Mycotoxins in nutrition.

Towers, N. R.

Proceedings of the Nutrition Society of Australia 4, 72-79 (1979) [8 ref. En] [Ruakura Anim. Res. Sta., Private Bag, Hamilton, New Zealand]

Aspects discussed are the widespread occurrence of mycotoxins, food losses due to mycotoxins, livestock losses due to mycotoxicoses, and the control of mycotoxicoses. The importance of preventing mycotoxicoses is stressed, because of the cost to food supplies and to human and animal health. Established control procedures and current research aimed at controlling facial eczema (caused by the toxin sporidesmin from *Pithomyces* sp.) in livestock are considered. AL

19

Effects of mycotoxins on mixed-function oxidase and adenosine triphosphatase systems in neonatal rats.

I. Aflatoxin B₁/rubratoxin B.

Phillips, T. D.; Siraj, M. Y.; Hayes, A. W.

Food and Cosmetics Toxicology 18 (3) 261-266 (1980) [30 ref. En] [Dep. of Pharmacol. & Toxicol., Univ. of Mississippi, Jackson, Mississippi 39216, USA]

20

"New mycotoxins" and their potential significance in foods.

Ciegler, A.

Journal of Food Safety 2 (2) 75-85 (1980) [37 ref. En] [S. Reg. Res. Cent., SEA, USDA, New Orleans, Louisiana 70179, USA]

Mycotoxins (excluding aflatoxin), e.g. zearalenone, trichothecenes, tremorgens, ochratoxin, cyclopiazonic acid, xanthomegnin, cytochalasin, secalonin acid, and PR toxin, are discussed as potential food contaminants. Diseases possibly caused by unknown mycotoxins are discussed. LH

Rapid high pressure liquid chromatography of patulin in apple juice.

Möller, T. E.; Josefsson, E.

Journal of the Association of Official Analytical Chemists 63 (5) 1055-1056 (1980) [9 ref. En] [Food Lab., Swedish Nat. Food Administration, S-751 26 Uppsala, Sweden]

A rapid method was developed for screening patulin in apple juice. The sample is extracted with ethyl acetate and the extract is cleaned up by extraction with an Na₂CO₃ solution. Patulin is determined after HPLC on a Spherisorb 5 µm ODS column with a UV detector set at 276 nm. The detection limit of the method is 5 µg/l and recovery is 70-75%. AS

22

The fate of T-2 toxin in corn wet milling.

Collins, G. J.

Dissertation Abstracts International, B 40 (10) 4724: Order no. 80-08867, 134pp. (1980) [En] [Rutgers Univ., New Brunswick, New Jersey 08903, USA]

Corn contaminated with T-2 toxin was produced by growing *Fusarium tricinatum* on dent corn. The contaminated corn was processed in bench-scale wet milling equipment. Methanol/water extracts of the corn and of its wet milled products were purified by TLC and analysed by GLC, the presence of T-2 toxin being confirmed by GLC-MS. Results indicated that the toxin was not destroyed by steeping. Approx. 70% of the toxin initially present in the corn occurred in the resulting solubles fraction, while 26% was evenly distributed between the germ, gluten and fibre, and the remainder was found in the starch. In another study, T-2 toxin was processed in model systems simulating alkali refining of crude corn oil and partial acid hydrolysis of corn starch. T-2 toxin added to the alkali refining system was not detectable by TLC after processing. The level of T-2 toxin in the acid hydrolysis system was significantly reduced by processing. The toxin was also subjected to a less vigorous acid hydrolysis process; 2 T-2 toxin diols, 2 triols and 1 tetraol were identified by GLC-MS in the reaction mixture. JA

23

Micro high performance liquid chromatography determination of PR toxin.

Danieli, B.; Bianchi-Salvadori, B.; Zambrini, A. V.

Milchwissenschaft 35 (7) 423-426 (1980) [9 ref. En, de] [Istituto di Chimica Organica, Fac. di Sci., Univ. degli Studi, Milan, Italy]

The micromethod proposed uses a simple, inexpensive miniaturized HPLC apparatus (JASCO Familic-100 instrument), µC₁₈-Bondapak at stationary phase and water/acetonitrile (65:45) as eluant. After chromatographic separation, the PR toxin is detected at 250 nm. Benzophenone was used as internal standard for detn. of the toxin. Analysis of extracts of culture media in which *Penicillium roqueforti* had been grown, demonstrated that the method could measure 0.2 ng PR toxin, and that it would enable small quantities of PR toxin in cheeses to be detected. [See also FSTA (1980) 12 4P785.] MEG

24

[Toxic metabolites produced by *Aspergillus* *egyptiacus*.]

Moubasher, A.-A. H.; El-Kady, I. A.; Gabry, M. S. E.; Shoreit, A. A.

Pakistan Journal of Scientific and Industrial Research 22 (1/2) 50-54 (1979) [16 ref. En] [Assiut Univ., Assiut, Egypt]

The toxicity of a crude chloroform extract of *A. egyptiacus* was examined through histological and histochemical effects in mice, and inhibition of the growth of some bacteria and fungi. RM

25

[Decomposition of trichothecenes during food processing.]

Kamimura, H.; Nishijima, M.; Saito, K.; Yasuda, K.; Ibe, A.; Nagayama, T.; Ushiyama, H.; Naoi, Y.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 20 (5) 352-357 (1979) [3 ref. Ja, en] [Tokyo Metropolitan Res. Lab. Public Health, Hyakunincho 3-chome, Shinjuku-ku, Tokyo, Japan]

The decomposition of trichothecenes in laboratory prepared bread and noodles was investigated. After the manufacturing and cooking processes, about 50% of the added mycotoxins remained in the test foods. The alkaline brine used in Chinese noodle processing strongly decomposed the mycotoxins. TM

26

Simultaneous determination of the *trans* and *cis* forms of zearalenone in cereal products by high-performance liquid chromatography with voltammetric detection.

Smyth, M. R.; Frischkorn, C. G. B.

Analytica Chimica Acta 115, 293-300 (1980) [11 ref. En] [Inst. of Chem., Inst. 4: Applied Physical Chem., Nuclear Res. Cent. (KFA), D-5170 Jülich, Federal Republic of Germany]

Zearalenone is shown by NMR, to exist in the *trans* and *cis* forms both in methanolic solution and in cereal products. Conversion of the *trans* to the *cis* isomer is enhanced by effects of UV irradiation. A method is described for simultaneous detn. of the 2 isomers by using HPLC with voltammetric detection. A linear calibration is operative in the range 3-300 ng zearalenone, Conc. of *trans*- and *cis*-zearalenone in wheat and corn down to 5 ng/g can be determined in 10-g cereal samples. AS

27

[Determination of roquefortine and PR toxin by UV-densitometry.] UV-densitometrische Analyse von Roquefortin und PR Toxin.

Engel, G.

Journal of Chromatography 170 (1) 288-291 (1979) [6 ref. De] [Bundesanstalt für Milchwirtschaft, D-2300 Kiel, Federal Republic of Germany]

Roquefortine and PR toxin were prepared from *Penicillium roqueforti* mycelium or culture liquor by the method of Scott et al. [FSTA (1977) 9 11P1851] and reference preparations were obtained from Canada. TLC on silica gel was carried out with roquefortine using chloroform/methanol/28% NH₄OH solution (90:10:1), and with PR toxin using toluene/ethyl acetate/acetic acid (5:4:1) as mobile phases; the corresponding R_f were approx. 0.4 and 0.7, resp.; and densitometry was carried out using the Shimadzu UV210A photometer at 310 and 257.5 nm, resp. 0.15 µg of either compound could be detected. SKK

28

[Screening method for determination of various mycotoxins in food.] Verfahren zur Bestimmung verschiedener Mykotoxine in Lebensmitteln.

Gertz, C.; Böschmeyer, L.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 171 (5) 335-340 (1980) [19 ref. De, en]

[Chem. Untersuchungsamt der Stadt Hagen, Pappelstrasse 1, D-5800 Hagen, Federal Republic of Germany]

A simple analytical method for multiple mycotoxins was developed for detecting aflatoxin B₁, B₂, G₁, G₂, M₁, and M₂, sterigmatocystin, penicillin acid, ochratoxin A and patulin. These mycotoxins were extracted with ethyl acetate. The extract was cleaned up by chromatography on silica mini-column. Each fraction was separated by TLC. The final evaluation of the TLC-plates was carried out by fluorodensitometry. A considerable increase in fluorescence intensity was achieved by spraying the plates with paraffin after development. The detection limits of fluorescent mycotoxins and the fluorescent derivatives of penicillic acid and sterigmatocystin were lowered to 1:10 up to 1:100. Spots of patulin were measured by fluorescence quenching. AS

29

Insecticide inhibition of growth and patulin production in *Penicillium expansum*, *Penicillium urticae*, *Aspergillus clavatus*, *Aspergillus terreus*, and *Byssosclamyces nivea*.

Draughon, F. A.; Ayres, J. C.

Journal of Agricultural and Food Chemistry 28 (6) 1115-1117 (1980) [17 ref. En] [Dep. of Food Sci., Univ. of Georgia, Athens, Georgia 30602, USA]

30

Mycotoxin production by *Alternaria* species grown on apples, tomatoes, and blueberries.

Stinson, E. E.; Bills, D. D.; Osman, S. F.; Siciliano, J.; Ceponis, M. J.; Heisler, E. G.

Journal of Agricultural and Food Chemistry 28 (5) 960-963 (1980) [25 ref. En] [E. Reg. Res. Cent., USDA, Philadelphia, Pennsylvania 19118, USA]

Known toxigenic strains of *Alternaria alternata*, *A. tenuissima*, and *A. solani*, isolated from a variety of plant materials, were cultured on apple and tomato slices. Wild strains of *Alternaria* sp. were isolated from commercial blueberries and tomatoes and reinoculated on their respective lightly crushed (blueberries) or sliced (tomatoes) host fruit in the laboratory. All fruits were treated under mild conditions to eliminate indigenous

After incubation for 21 days at 21°C, the mycotoxin content of the cultured fruits was determined by reverse-phase HPLC. Most of the known toxigenic strains and wild isolates of *Alternaria* produced tenuazonic acid (TeA), alternariol (AOH), and alternariol monomethyl ether (AME). Many cultures also produced altenuene (ALT) and altertoxin I (ATX-I). Ranges of concn. (mg mycotoxin produced/100 g fruit substrate) were as follows: TeA, 0-137.30; AOH, 0-56.90; AME, trace-20.90; ALT, 0-2.06. - ATX-I was not determined quantitatively but was detected in about one-half of the cultured fruits. Some of the wild isolates produced greater amounts of mycotoxins than the known toxigenic strains of *Alternaria*. AS

31

Toxic aspergilli from pistachio nuts.

Mojtahedi, H.; Rabie, C. J.; Lübben, A.; Steyn, M.; Danesh, D.

Mycopathologia 67 (2) 123-127 (1979) [21 ref. En] [Dep. of Horticulture, Univ. of Isfahan, Isfahan, Iran]
Pistachio nut samples taken during various stages of development from orchards in Iran, showed that contamination with fungi occurred mainly during the later stages of nut development. Members of the genera *Aspergillus* and *Penicillium* occurred most frequently. Of the *Aspergilli*, the spp. *A. niger*, *A. flavus* and *A. fischeri* var. *spinosus* occurred most frequently, followed by *A. terreus*, *A. tamarii* and *A. nidulans*. 22 isolates comprising 13 spp. were tested for toxicity to ducklings. Isolates of known toxic fungi included *A. flavus*, *A. niger*, *A. parasiticus*, *A. ochraceus*, *A. versicolor*, *A. nidulans* and *A. terreus*. The toxicity of *A. fischeri* var. *spinosus* is reported. Chemical analysis showed that all isolates of *A. flavus* and *A. parasiticus* produced aflatoxin B₁, the isolates of *A. versicolor* and *A. nidulans* produced sterigmatocystin while the toxic isolate of *A. ochraceus* did not produce ochratoxins. AS

32

High pressure liquid chromatographic determination of satratoxins G and H in cereal grains.

Stack, M. E.; Eppley, R. M.

Journal of the Association of Official Analytical Chemists 63 (6) 1278-1281 (1980) [7 ref. En] [Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

An HPLC method is described for detection and quantitative detn. of satratoxins G and H in cereal grains. The toxins are extracted from the sample by blending with methanol-water (55 + 45) in the presence of hexane, followed by partitioning into chloroform. The chloroform extract is further purified on a 10 g silica gel column. A high pressure liquid chromatograph, equipped with a microparticle silica gel column and a 254 nm absorbance detector, is used for the detn. Additional confirmation of identity is obtained by MS or by a brine shrimp bioassay of the HPLC eluates corresponding to the retention times of satratoxins G and H. Recoveries of added satratoxins G and H from wheat samples averaged 65% for G and 71% for H (200-1000 mg/kg). The coeff. of variation were 15% for G and 14% for H. The lower limit of detection was 200 µg/kg for wheat. Analysis of corn,

oats, and barley samples (400 µg/kg of each toxin added) gave comparable recoveries. Only the corn extract exhibited HPLC interferences at the retention time for satratoxin H. The method was also used to analyse samples of corn, oats, wheat, barley, and rice on which *Stachybotrys atra* had been cultured. AS

33

Contribution to the determination of fusarium toxins.

Bata, A.; Lasztity, R.; Balla, J.

Acta Alimentaria 9 (2) 99-106 (1980) [17 ref. En] [Dep. of Biochem. & Food Tech., Tech. Univ. of Budapest, H-1502 Budapest, Muegyetem rkp 3, Hungary]

Development of new, more accurate methods for detn. of mycotoxin content of foods is closely connected with improvement of the extraction of mycotoxins and purification of raw extracts. Maize samples infected by *Fusarium culmorum* were extracted with ethyl acetate. After evaporation of solvents the mycotoxin-containing material was again dissolved in petroleum ether and methanol/water mixture, and purified by column chromatography. After a 2nd purification the purified extract was investigated by TLC, gas chromatography and MS. A high degree of purity was demonstrated by mass spectra. AS

34

Survey of 1977 Midwest corn at harvest for aflatoxin.

Shotwell, O. L.; Bennett, G. A.; Goulden, M. L.; Shannon, G. M.; Stubblefield, R. D.; Hesseltine, C. W. *Cereal Foods World* 25 (1) 12, 14 (1980) [10 ref. En] [N. Reg. Res. Cent., Agric. Res., Sci. & Education Administration, USDA, Peoria, Illinois 61604, USA]

923 Midwest corn samples collected in Illinois, Indiana, Iowa, Kansas, Missouri, Nebraska, Ohio and Wisconsin in 1977, were examined for aflatoxin. Samples were also examined before shelling for *Fusarium* damaged ears. 47 samples with the most severely damaged ears were analysed for zearalenone. Only 3 of the 923 corn samples analysed had aflatoxin levels > 20 parts/billion (p.p.b.) (the FDA guideline for aflatoxin in corn) an incidence of 0.3%. Of the positive samples > 20 p.p.b., 2 (30 and 151 p.p.b.) came from Missouri and 1 (42 p.p.b.) from Kansas. No aflatoxin positive samples were found in samples from Illinois, Indiana, Nebraska, Ohio or Wisconsin. The incidence of detectable toxin was 0.6%. Of the cracked samples examined for bright greenish yellow (BGY) particles associated with *Aspergillus flavus* and possible aflatoxin, 79% had no BGY, 17% had 1 BGY particle and 3% had at least 2 BGY particles/kg. Almost all the corn samples (914) had some *Fusarium* damage; 431 had fewer than 10% damaged ears. Only 70 of the samples had > 49% ears damaged by visible *Fusarium* growth. No zearalenone was detected in any of the 47 samples analysed. VJG

35

Intestinal fragility during ochratoxicosis and aflatoxicosis in broiler chickens.

Warren, M. F.; Hamilton, P. B.

Applied and Environmental Microbiology 40 (3) 641-645 (1980) [21 ref. En] [Dep. of Poultry Sci., N. Carolina State Univ., Raleigh, N. Carolina 27650,

Results are presented showing that dietary ochratoxin reduces the breaking strength of the large intestine of chickens, whereas dietary aflatoxin has no such effect. These results are discussed in relation to possible problems with contamination and consequent condemnation of carcasses as a result of rupture of the large intestine during handling; a field study showed a high incidence of ruptured large intestines in a group of chickens fed ochratoxin-contaminated feed. AJDW

36

[Occurrence of toxigenic penicillia in meat products.]

Vorkommen toxinogener Penicillien bei
Fleischerzeugnissen. [Lecture]
Leistner, L.; Eckardt, C.

Proceedings of the European Meeting of Meat Research Workers No. 25, 6.9:485-6.9:491 (1979) [37 ref. De, en, fr, ru] [Bundesanstalt für Fleischforschung, Kulmbach, Federal Republic of Germany]

Toxin formation by 1108 isolates of *Penicillium* spp. from foods and feeds was studied. The most common spp. was *P. verrucosum* var. *cyclopium* (412 isolates, i.e. 37%). 20 different mycotoxins were identified, formed by 679 (61%) of the isolates. 891 isolates (80%) were toxigenic. 628 *Penicillium* strains were isolated from meat products; 489 isolates (78%) were toxigenic. It is concluded that mould growth on meat products should be controlled, e.g. by means of potassium sorbate, and that only non-toxic starter cultures should be used in the manufacture of mould-ripened meat products. [See FSTA (1981) 13 5S668.] STI

37

[Studies on mycotoxins in foods. X. Analytical procedure and determination of sterigmatocystin.]

Kan, K.; Nishijima, M.; Kanmuri, M.; Nakazato, M.; Ariga, T.; Ishikawa, F.; Naoi, Y.

Annual Report of Tokyo Metropolitan Research Laboratory of Public Health 29 (1) 244-249 (1978) [9 ref. Ja] [Tokyo Metropolitan Res. Lab. of Public Health, 24-1, Hyakunincho 3 chome, Shinjuku-ku, Tokyo, 160 Japan]

A procedure for detn. of sterigmatocystin in foods is described based on extraction with methanol + 4% KCl solution, concentration of the methanol extract by evaporation, clean-up of the extract by column chromatography, evaporation to dryness, taking up the residue in chloroform, and analysis by TLC on silica gel 60 using a benzene/methanol/acetic acid (90:5:5) solvent system. The plate is sprayed with 20% $AlCl_3$ in ethanol and heated for 20 min at 80°C; sterigmatocystin is then determined by UV spectrometry at 365 nm, or fluorodensitometry (excitation 355 nm, emission 496 nm). Data are given for recovery of sterigmatocystin added to various foods (rice, miso, corn, wheat). For 40 parts/billion (p.p.b.) added sterigmatocystin, recovery ranged from 90% (miso) to 103% (wheat). For 200 p.p.b. added sterigmatocystin, recovery ranged from 92% (corn) to 98% (rice). AJDW

38

Proceedings of a third meeting on mycotoxins in animal disease, held at the National College of Food Technology, Weybridge, 17-18 April 1978.

[Conference proceedings]

Pepin, G. A.; Patterson, D. S. P.; Shreeve, B. J. (United Kingdom, Ministry of Agriculture, Fisheries & Food, Agricultural Development & Advisory Service) (Editors)

viii + 82pp. (1979) [many ref. En] Pinner, Middlesex, UK; Ministry of Agriculture, Fisheries & Food. Price £5.85

The 19 papers presented at this meeting are divided into 4 sections: the natural occurrence of mycotoxins; methods of analysis for mycotoxins; animal diseases possibly associated with feed-borne mycotoxins; and public health implications of mycotoxins. Papers included: Moulds and mycotoxins in animal foodstuffs - reports of ADAS microbiologists, by R. Syrett (pp. 4-7). Fungi and mycotoxins detected in samples from the infestation control service 1976-77, and recent laboratory experiments on mycotoxins at PICL, by J. H. Clarke & E. V. Niles (pp. 8-12, 4 ref.; includes a table on mycotoxins detected in cereals, cereal products, pulses and pulse products, oilseeds, oilseed products, dried fruit and fruit products, spices, condiments and flavourings, cocoa beans and cocoa products). Food surveillance in the UK and abroad [report of a working party on mycotoxins, set up in 1975], by D. G. Lindsay (pp. 13-15, 7 ref.; projects which have already been commissioned and for which results are just beginning to be available include incidence and level of aflatoxins in edible nuts, mycotoxins in flour and oatmeal, maize and maize products, meat and meat products, coffee and cocoa, pulses, fruit juices and products, mould-spoiled food, and levels and incidence of aflatoxin M_1 in dairy products). The use of gas chromatography/mass spectrometry for the detection of some mycotoxins, by D. T. Coxon & K. R. Price (pp. 23-24, 5 ref.). The development of extraction and high performance liquid chromatography methods of analysis for mycotoxins, by J. P. Chaytor & M. J. Saxby (pp. 25-27, 9 ref.). The use of high performance liquid chromatography for the measurement of mycotoxin in food, by N. T. Crosby & D. C. Hunt (pp. 34-36, 6 ref.). Aflatoxin in animal feedstuffs and its 'carry-over' into food products, by D. S. P. Patterson (pp. 71-72, 4 ref.). [See also FSTA (1981) 13 6P1046.] DMK

39

Mycotoxins. [Review]

Mirocha, C. J.; Pathre, S. V.; Christensen, C. M.

Advances in Cereal Science and Technology 3, 159-225 (1980) [many ref. En] [Dep. of Plant Path., Univ. of Minnesota, St Paul, Minnesota, USA]

Aspects covered in this comprehensive review are: introduction (definition of mycotoxins, occurrence, fungi that produce mycotoxins); aflatoxins, dealing with their role in public and animal health, chemical and physical properties, naturally occurring derivatives, biosynthesis, metabolism, molecular basis of action, occurrence in foodstuffs, and control and detoxification; zearalenones,

dealing with the fungus and conditions for production, chemical composition, derivatives and properties, methods of analysis, and natural occurrence; trichothecenes, dealing with chemical composition and properties, method of analysis, natural occurrence, biosynthesis, molecular mode of action, and toxicity; ochratoxin, including occurrence, properties, analysis methods, toxicity, and biosynthesis; and other mycotoxins, covering patulin, yellowed-rice toxins, tremorgenic toxins and rubratoxin. 15pp. of ref. are included. [See FSTA (1981) 13 6M574.] AL

40

Mycotoxin and odor formation in moist cereal grain during granary storage.

Abramson, D.; Sinha, R. N.; Mills, J. T.

Cereal Chemistry 57 (5) 346-351 (1980) [25 ref. En] [Agric. Canada, Res. Sta., Winnipeg, Manitoba, R3T 2 M9, Canada]

Half-bushel parcels of barley, wheat, and oats at 21% moisture content were placed inside bulk stored oats in a farm granary for 20 wk during summer and autumn in Manitoba to study quality changes. Temp., moisture, O₂ and CO₂ levels, microfloral incidence and abundance, seed germination, free fatty acids, aflatoxins (B₁, B₂, G₁ and G₂), zearalenone, citrinin, penicillic acid, ochratoxin A, sterigmatocystin, and fungal volatiles were monitored during storage. By 4 wk, ochratoxin A had formed at detectable levels in barley and wheat but not in oats; barley contained > 5 × more ochratoxin A than did wheat after 20 wk. Strains of *Penicillium verrucosum* var. *cyclopium* were associated with ochratoxin A production. No other mycotoxins were detected. The fungal volatiles increased 10-15 × by 7 wk and declined to control levels by 16 wk. Of the 3 known fungal odours tentatively identified, amounts of 1-octanol were greater than those of 3-methyl-1-butanol and 3-octanone. Of the 3 grains, barley showed the least heating, moisture increase, O₂ decrease, CO₂ increase, fat acidity value increase, and germination loss. AS

41

Dairy handbook. [Book]

Alfa-Laval AB

301pp. (1980?) [En] Lund, Sweden; Alfa-Laval AB. Price \$25.00

This book is largely devoted to aspects of milk processing and equipment used, but deals also with milk composition and properties, and milk production on the farm. It comprises the following chapters: Primary production of milk (pp. 1-6). The chemistry of milk; basic chemical concepts, composition, changes in milk and its constituents during storage and by heat (pp. 7-22). Microorganisms (pp. 23-38). Collection and reception of milk (pp. 39-47). The building blocks of dairy processing; equipment, fittings, heat generation, refrigeration (pp. 49-93). General milk treatment; pasteurization, UHT, clarification and cream separation, fat standardization (pp. 95-141). Market milk products; milk, cream (pp. 143-151). Sterilization; in-bottle, UHT (pp. 153-159). Starter cultures (pp. 161-169). Cultured milk products; yoghurt, long-life yoghurt, kefir, filmjolk, laktofil, gräddfil, buttermilk (pp. 171-186). Butter;

buttermaking, new types of spreads (pp. 187-198).

Anhydrous milk fat - butter oil; manufacture, fractionation of anhydrous milk fat (pp. 199-205).

Cheese; cheese milk treatment, mechanized cheesemaking, processed cheese (pp. 207-226).

Evaporation (pp. 227-229). Whey processing (pp. 231-238). Condensed milk; evaporated milk, condensed sweetened milk (pp. 239-244). Milk powder (pp. 245-251). Recombination of milk (pp. 253-258). Ice cream (pp. 259-265). Cleaning of dairy equipment (pp. 267-278). Automation (pp. 279-301). The book is profusely illustrated with drawings and diagrams. FL

42

Natural occurrence of the mycotoxin penitrem A in moldy cream cheese.

Richards, J. L.; Arp, L. H.

Mycopathologia 67 (2) 107-109 (1979) [9 ref. En] [Nat. Anim. Disease Centre, USDA, PO Box 70, Ames, Iowa 50010, USA]

A study was made of refrigerated cream cheese that was responsible for the intoxication of 2 dogs. A culture of spores removed from the blackish-dark green growth of fungus covering the entire cheese, revealed a single cell isolate which was identified as *Penicillium crustosum*. TLC analysis of an extract of the toxic cheese revealed the presence of the mould toxin penitrem A. This is thought to be the 1st definitive case of the natural occurrence of penitrem A in a food commodity. MC

43

[Investigation into the carry-over of T-2 toxin in chickens.] Untersuchung zum Carry-over von T-2 Toxin bei Hühnern.

Hofmann, G.

Fleischwirtschaft 60 (10) 1908-1910 (1980) [many ref. De, en]

The carry-over of *Fusarium solani* T-2 toxin from the feed into edible tissues of chickens was investigated. No carry-over was observed in broilers fed ad lib. with a diet containing 15 p.p.m. of the toxin. The detection limit of the analytical method was 15 parts/billion T-2 toxin in muscle and liver tissue. When adult birds (roosters) ingested rapidly a large amount of the toxin, it reached max. concn. in the liver within 2-3 h but disappeared within 4½ h after ingestion. HT-2 toxin was detected as a metabolite of T-2 toxin for a few h (3-4½ h after ingestion). AS

44

[Quantitative determination of penicillic acid in foods of plant origin.] Quantitative Bestimmung der Penicillinsäure in pflanzlichen Lebensmitteln.

Ehnert, M.; Popken, A. M.; Dose, K.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 172 (2) 110-114 (1981) [21 ref. De, en] [Inst. für Biochemie der Johannes-Gutenberg-Univ., D-6500 Mainz, Federal Republic of Germany]

A procedure for quantitative detn. of penicillic acid in foods of plant origin (peas, rice, oatmeal, and coconut flakes) is described. For extraction a 1 + 1 mixture of dichloromethane and methanol is used. The final

separation of penicillic acid is carried out by 2-dimensional TLC. Penicillic acid is (in situ) converted into a strongly fluorescent derivative (max. emission at 440–445 nm with excitation at 365–370 nm) by reaction with diphenylboric acid 2-aminoethylester using an immersion procedure. Fluorescence intensity is linearly proportional to the amount of penicillic acid within the concn. range 50–600 ng/spot. The recovery rate is about 95%. The lower limit for semiquantitative detection of penicillic acid is about 5 ng/spot. AS

40

Food toxins. [Review]

Sreenivasamurthy, V.

Journal of Food Science and Technology, India 17 (1/2) 89–94 (1980) [51 ref. En] [Cent. Food Tech. Res. Inst., Mysore-570 013, India]

The review covers natural toxins inherent in foods, e.g. trypsin inhibitor, haemagglutinins, amylase inhibitor, and lathyragens; and acquired toxins e.g. bacterial toxins (from staphylococci, *Clostridium perfringens* and *Bacillus cereus*) and mycotoxins. The implications of these toxins and their remedial measures are indicated. CFTRI

41

Aflatoxin production on some Egyptian agricultural food commodities.

Mabrouk, S. S.; El-Shayeb, N. M. A.

Chemie Mikrobiologie Technologie der Lebensmittel 6 (6) 167–170 (1980) [23 ref. En, de] [Lab. of Natural Products, Nat. Res. Cent., Dokki, Cairo, Egypt]

2 *Aspergillus flavus* strains (M 93 and No. 182) were grown on various substrates, including grains, legumes, garlic, onion and oil seeds, and aflatoxin formation when incubated for 3, 6, 12, 18, 24 or 30 days at 30°C was examined. Garlic inhibited mould growth. Lentils supported fungal growth but no aflatoxin was detected. Onion was also a poor substrate for aflatoxin production, especially for *A. flavus* M 93. All other substrates supported fungal growth and aflatoxin formation. Most of the carbohydrate-rich substances supported aflatoxin yields larger than those of the oil seeds when incubated for 3–12 days, but smaller yields when incubated for 18–30 days. Max. aflatoxin yields produced by *A. flavus* M 93 and No. 182 were, resp., (µg aflatoxin/kg substrate) on sesame seeds after 12 days (approx. 18 500) and on sunflower seeds after 18 days (approx. 16 000). RAW

42

[Densitometric method for measuring patulin in fruit juices.]

Siriwardana, M. G.; Lafont, P.

Journal of Chromatography 173 (2) 425–428 (1979) [11 ref. Fr] [INSERM, SCR 8, Microbiol. Appliquee a l'Alimentation a la Nutr., 44 Chemin de Ronde, BP No. 40, 78110 Le Vesinet, France]

The method consists of shaking 50 ml apple juice with 50 ml of a mixture of isopropanol:ethyl acetate (60:40 v/v) and then adding 10 g NaCl and shaking for a

further 3 min. The organic phase is removed, dried over anhydrous Na₂SO₄, concentrated under vacuum at < 50°C and then diluted with 25 ml ethyl acetate and 75 ml benzene. After clean up on a silica gel column, the eluate is concentrated under vacuum, and the residue is dissolved in 500 ml chloroform and analysed by TLC on silica gel 60 using pentane:ethyl acetate (96:4 v/v) and then (in the same direction) isopropyl ether:pentane:ethanol:pyridine (84:12:4:0.8 v/v). The developed TLC plate is sprayed with a solution containing 0.9 ml glacial acetic acid, 1 ml alanine and 8.1 ml distilled water. After heating for 10 min at 80°C, the intensity of the fluorescent greenish yellow spot is measured densitometrically. In this way 0.01–0.10 µg patulin could be detected. In tests with apple juice and grape juice containing 10–200 µg added patulin/l, the mean recovery of mycotoxin was 91.2%. The method of analysis is considered to be more satisfactory than that described in FSTA (1974) 6 10H1687. MEG

43

Thermal destruction of patulin in berries and berry jams.

Lindroth, S.

Journal of Food Safety 2 (3) 165–170 (1980) [14 ref. En] [Tech. Res. Centre of Finland, Food Res. Lab., Biologinkuja 1, SF 02150 Espoo 15, Finland]

Blackcurrant, blueberry and strawberry mixtures (2 kg) with 0 or 440 g/kg sucrose (equal to the concn. in jam) and 1 or 15 mg/kg patulin toxin added, were heated. Patulin was analysed by TLC after 0, 10, 20 and 30 min boiling (for the 15 mg/kg samples) or after 0 and 30 min (for the 1 mg/kg samples). pH and A_w were also analysed. Sucrose seemed to protect the patulin; half-lives were 31, 65 and 77 resp. in blackcurrant, blueberry and strawberry, without sucrose and with 15 mg/kg patulin added, and 113, 144 and 112 correspondingly with sucrose added. A_w values were 0.99 for unsweetened and 0.95 for sweetened berries; pH values were unaffected by sucrose, being 3.5 for blackcurrant and 3.1 for strawberry and blueberry. LH

44

Confirmation of penicillic acid by high pressure liquid and gas-liquid chromatography [in foods].

Phillips, T. D.; Ivie, G. W.; Heidelbaugh, N. D.; Kubena, L. F.; Cysewski, S. J.; Hayes, A. W.; Witzel, D. A.

Journal of the Association of Official Analytical Chemists 64 (1) 162–166 (1981) [17 ref. En] [Dep. of Vet. Public Health, Texas A&M Univ., College Station, Texas 77843, USA]

45

The effect of selected agricultural chemicals on growth and secondary metabolism of fungi producing aflatoxin, patulin or citrinin.

Draughon, F. A.

Dissertation Abstracts International, B 40 (6) 2590: Order no. 79-23103, 179pp. (1979) [En] [Univ. of Georgia, Athens, Georgia 30601, USA]

Citrinin production and growth of *Penicillium citrinum* was inhibited by naled, dichlorvos, malathion and diazinon by > 75% and by pyrethrum, mevinphos, ethion and allethrin by 740% at 100 mg/l. Naled and its breakdown products inhibited patulin production by *P.*

urticae at 10 and 1 mg/l and if applied pre-inoculation at 100 mg/l stopped growth and patulin production for 15 and 30 days, resp. This inhibitory effect was used to protect apples in storage at 25°C. Inhibition by naled is not sp. dependent as it is for Sevin [carbaryl] and pyrethrum. Naled also completely inhibited aflatoxin B₁, B₂, G₁ and G₂ production by *Aspergillus parasiticus* (at 100 mg/l), but at lower concn. dichlorvos proved more effective. Carbamate insecticides inhibited aflatoxin B₁ production at 100 mg/l, B₁ being the most toxic and the most resistant of the aflatoxins, followed by G₁, G₂ and B₂. LH

46

High-performance liquid chromatographic analysis of the mycotoxin secalonic acid D and its application to biological fluids.

Reddy, C. S.; Reddy, R. V.; Hayes, A. W.

Journal of Chromatography 208 (1) 17-26 (1981) [6 ref. En] [Dep. of Pharmacology & Toxicology, Univ. of Mississippi Med. Cent., Jackson, Mississippi 39216, USA]

Secalonic acid D (SAD) is an acutely toxic, teratogenic and possibly mutagenic fungal metabolite produced in corn by *Penicillium oxalicum*. Using UV absorbance at 340 nm as a means of detection, SAD was resolved as a sharp peak by reversed-phase HPLC on a small particle (10 µm) µBondapak C₁₈ column in 4 min by an acetonitrile/water/glacial acetic acid/tetrahydrofuran (5:3:0.5:0.5 for solvent system A and 4:3:0.5:0.5 for solvent system B) elution solvent system. The flow-rates for the 2 solvent systems (A and B) were 1.5 and 1.7 ml/min; column operating pressures of 1500 and 1800 lb/in², resp., resulted. The relationship between peak height or peak area and the quantity of SAD injected was linear over a range of 1-50 ng. Detection was very sensitive with lower limits of detection of 0.6 and 0.7 ng of SAD in solvent systems A and B, resp. Retention times, peak heights and peak areas were highly reproducible in both solvent systems. Detection of SAD in spiked urine, bile and plasma samples was carried out. AS

47

[Sterigmatocystin in cows' milk and the occurrence of aflatoxin in milk products.] Über die Sterigmatocystinausscheidung in Kuhmilch und über das Vorkommen von Aflatoxin in Milchprodukten. [Thesis]

Kraus, P. V.

93pp. (1978) [De] München, Federal Republic of Germany; Tech. Univ.

In 3 laboratory trials, 35 samples of human milk, 46 of infant feeds and 9 of milk products were tested for aflatoxin; results were negative. Sterigmatocystin was carried into milk, though it was detectable only at about 100 ng/100 ml milk (or 30 ng in acetylated form). In field trials with 98 samples of mixed farm milk tested at Weißenstephan Dairy, Federal Republic of Germany 20% of samples contained aflatoxin but only 2 contained sterigmatocystin. A study of the distribution of sterigmatocystin during cheesemaking showed that almost all appeared in the curd (in contrast to aflatoxin M₁ which divides more or less equally between the curd and whey). [From *Milchwissenschaft* (1979) 34 (7) 430.] RBS

48

High pressure liquid chromatographic determination of penicillic acid residues in poultry. [Lecture]

Hanna, G. D.; Phillips, T. D.; Cysewski, S. J.;

Kubena, L. F.; Ivie, G. W.; Heidelbaugh, N. D.;

Witzel, D. A.; Hayes, A. W.; Williams, W. L.

Federation Proceedings 39 (3, II) 1102 (1980) [En]

[Dep. Vet. Public Health, Texas A&M Univ., College Station, Texas 77843, USA]

Penicillic acid (PA) is a tautomeric mycotoxin ($\Delta\alpha\beta$ - γ -hydroxylactone, or open ring substituted γ -keto hexenoic acid) with reported cardiotoxic, teratogenic and carcinogenic activity. Its presence in contaminated feed represents a potential public health hazard. A reverse-phase HPLC method is proposed for determining authentic PA residues in poultry tissues. Optimization of chromatography was achieved for PA using a mobile phase consisting of acetonitrile:H₂O. PA was detected by UV absorption at 254 nm, identified by retention time and quantified by peak area determined by digital electronic integration. Spiked plasma, parenchymal tissues, brain, muscle, alimentary and intestinal tract contents were homogenized, sonicated and acid hydrolysed followed by extraction with ethyl

acetate and subsequent transfer to an acetonitrile/water/hexane solution resulting in a rapid, reliable and sensitive method of recovery and quantitation of PA. Acute oral dosing of chicks with PA resulted in significant levels of the mycotoxin (detected by HPLC and confirmed by TLC) 4 h postdosing in kidney, heart, gizzard and contents, and intestinal contents. These results suggest the possibility of contamination of poultry by PA. [See FSTA (1981) 13 8A461.] AS

49

[Conditions for formation of ochratoxin A in dry sausages.]

Labie, C.; Tache, S.

Bulletin de l'Académie Vétérinaire de France 52 (4) 553-559 (1979) [Fr, en] [Lab. d'Hygiène & Ind. des Denrées Alimentaires d'Origine Anim., Ecole Nat. Vet. de Toulouse, 31076 Toulouse Cedex, France]

Studies were conducted, using a toxigenic strain of *Aspergillus ochraceus*, on the potential for growth and toxin production by toxigenic moulds on dry sausages at various stages of production and ripening. The results show that, for growth and toxin production, it is necessary for the sausage to be contaminated with the mould at a spore count of at least 10³-10⁵/g either before or shortly after filling into the casings, and then held at 22-26°C and 80-86% RH. Mould growth and toxin formation are slow at moisture concn. < 58% in the defatted product; no toxin formation is detectable at moisture contents < 50%. *Asp. ochraceus* does not develop on products dried for ≥ 3 wk before inoculation. Formation of up to 120 parts/billion ochratoxin A in the sausages was observed. Ochratoxin concn. decreased gradually during the later stages of ripening; however, appreciable quantities were present after ripening/drying for 60 days. AJDW

50

High-performance liquid chromatography of the mycotoxin sterigmatocystin and its application to the analysis of mouldy rice for sterigmatocystin.

Schmidt, R.; Mondani, J.; Ziegenhagen, E.; Dose, K. *Journal of Chromatography* 207 (3) 435-438 (1981) [10 ref. En] [Inst. für Biochem., Joh. Gutenberg Univ. Mainz, Joh. Joachim Becher Weg 30, 65 Mainz, Federal Republic of Germany]

Sterigmatocystin (closely related to aflatoxin B₁) is known to be hepatotoxic and is produced by several *Aspergillus* and *Penicillium* spp. The main producer is *Aspergillus versicolor*, which occurs on corn, bread, dried fruit, cheese, rice, soymeal and meat. A simple extraction and separation procedure for HPLC detn. of sterigmatocystin in mouldy rice is described. Mouldy material was extracted with acetonitrile/4% KCl in water, the extract was partitioned against n-hexane and chloroform, the solvent was evaporated, the residue was dissolved in methanol, placed on a bed of Sep-Pak C₁₈ and eluted with 50% methanol. Sterigmatocystin was completely retained than eluted with 60:40 methanol/water, filtered and injected into a HPLC system (described). Retention times on a μ Bondapak C₁₈ column with different methanol/water mixtures are tabulated and chromatograms of extracts are given for mouldy and non-mouldy rice. A linear gradient of 6:4 to 7:3 methanol/water was selected as eluent. Results were highly reproducible (coeff. of variation 4.39%) with a linear relation between peak area and mycotoxin injected over the range 25-1250 ng (correlation coeff. 0.9994). ELC

51

[Quantitative analysis of mycophenolic acid from thin layer plates by UV- and fluorescence densitometry!] Quantitative UV-densitometrische und fluorodensitometrische Analyse von Mycophenolsäure auf Dünnschichtplatten.

Engel, G.

Journal of Chromatography 207 (3) 430-434 (1981) [9 ref. De, en] [Inst. für Mikrobiol., Bundesanstalt für Milchforschung, Hermann-Weigmann-Strasse 1-27, D-2300 Kiel, Federal Republic of Germany]

Quantitative detn. of mycophenolic acid (MPA) produced as a metabolite by *Penicillium stoloniferum*, *P. brevicompactum* and *P. roqueforti* is desirable due to its possible toxicity. MPA can be identified by TLC, and after further treatment with NH₃ and diethylamine a blue fluorescence is obtained. Practical procedures are described and compared for detn. of UV spectra of solutions and thin layer plates and fluorescence spectra after NH₃ treatment. It is concluded that UV absorption at 250 and 350 nm gives reliable measurements over a range of values and is most suitable for quantitative analysis; measurements can be applied to detection of MPA in both culture media and mould-ripened cheese. Fluorescence measurements can provide additional confirmation. Limit of detection is 0.1 μ g/TLC spot for both methods. ELC

52

[Formation and distribution of sterigmatocystin in cheese inoculated with *Aspergillus versicolor* and *Aspergillus nidulans*.] Bildung und Verteilung von Sterigmatocystin in Käse nach Beimpfung mit *Aspergillus versicolor* und *Aspergillus nidulans*. Engel, G.; Teuber, M.

Milchwissenschaft 35 (12) 721-724 (1980) [11 ref. De, en] [Inst. für Mikrobiol., Bundesanstalt für Milchforschung, Kiel, Federal Republic of Germany]

Since *Aspergillus versicolor* and its mycotoxin sterigmatocystin have been isolated from naturally infected cheeses, autoclaved Tilsit cheese was infected with *A. versicolor* or *A. nidulans* (2 strains each). Incubation was for up to 60 days at 10°, 15° or 27°C. Max. mycotoxin (185 μ g/kg) was detected in cheese inoculated with 1 strain of *A. nidulans* and incubated for 60 days at 27°C, compared with $\leq 35\ 000$ μ g/kg when grown in a yeast sucrose nutrient broth. Both species and strains produced significant amounts of mycotoxin in the broth ($\leq 108\ 000$ μ g/kg). When spores of *A. nidulans* were spread on the surface of natural Wilstermarsch or Edam cheese, 1 strain produced appreciable amounts of mycotoxin (1750 μ g/kg) on the Wilstermarsch only. This was located within 8 mm of the surface, so that removal of 1 cm of the cheese would make it acceptable. The toxin was only produced on the cheese at room temp. and not at 15°C. BR

53

[Contamination of milk with mycotoxins.]

Kontamination der Milch mit Mykotoxinen. [Lecture] Schultz, G.

Deutsche Tierärztliche Wochenschrift 87 (6) 232-233 (1980) [2 ref. De] [Inst. für Tierernährung der Tierärztlichen Hochschule, Hanover, Federal Republic of Germany]

Of the mycotoxins, aflatoxins are the most dangerous because of the excretion of aflatoxin M₁ in milk of ruminants. Prolonged intake by cattle of 1 mg aflatoxin A/kg feed has a hepatotoxic effect; the intake of 2 mg aflatoxin B₁ results in a concn. of 1 μ g/kg milk, which is sufficient to increase the risk of liver cancer. Hence the permissible content in cattle feed is 50 μ g/kg. [See FSTA (1981) 13 9P1584.] BR

54

[Stability of zearalenone in aqueous solutions of some food additives.]

Matsuura, Y.; Yoshizawa, T.; Morooka, N.

Journal of the Food Hygienic Society of Japan

[*Shokuhin Eiseigaku Zasshi*] 20 (5) 385-390 (1979)

[8 ref. Ja, en] [Dep. of Food Sci., Okayama Prefectural Junior Coll., Ishima-cho, Okayama-shi, Okayama, Japan]

To study the behaviour of fusariotoxins during the storage, processing and cooking of food, the stability of zearalenone in aqueous solution of some food additives was investigated. Zearalenone (100 μ g) was incubated at various temp. in 1 ml of 0.00024-0.75% aqueous solutions (pH 5.0) of food additives, including potassium bromate, ammonium persulphate and H₂O₂. Although

zearalenone was very stable in neutral or acidic buffer solution, 56% of the mycotoxin was decomposed within 1 h at 100°C in an alkaline buffer solution (pH 12). The half-time of decomposition of zearalenone was about 5 min at 80–100°C and about 30 min at 60°C in 0.5% ammonium persulphate solution, and about 40 min at 80°C in 0.5% H₂O₂ solution. In 0.03% solution of ammonium persulphate and 0.01% of H₂O₂ solution (these values are defined by the food hygiene laws in Japan) zearalenone was clearly decomposed. Zearalenone was quite stable in the potassium bromate solution. After 1 day at room temp. the decomposition levels of zearalenone in 0.5% ammonium persulphate and H₂O₂ solution reached 70% and 45%, resp. Zearalenone was completely decomposed in the aqueous solutions of both additives after 7–10 days at room temp. In both 0.03% ammonium persulphate and 0.01% H₂O₂ solution, the decomposition of zearalenone reached 55% after 9 days at room temp. AS

55

Mycotoxins in foodstuffs. XIV. The formation of the mycotoxin ochratoxin A by *Aspergillus ochraceus* in bread.

Reiss, J.

Deutsche Lebensmittel-Rundschau 77 (1) 27–32 (1981) [120 ref. En, de, fr] [Mikrobiol. Lab. Grahamhaus Studt KG, 6550 Bad Kreuznach, Federal Republic of Germany]

Studies were conducted to evaluate growth and ochratoxin formation by 4 moulds known to produce ochratoxin A (*Aspergillus ochraceus* NRRL 3174, and 3 *Penicillium* isolates, sp. 384 sp. 386 and sp. 395) and 2 other moulds (*Asp. ochraceus* CBS 108.08 and *Asp. ochraceus* 6514) on 5 bread types: (i) wholemeal wheat bread; (ii) wholemeal wheat bread with wheat germ, (iii) wholemeal wheat bread with linseed, (iv) wholemeal rye bread, and (v) wholemeal rye bread with coarsely comminuted wheat. Acidity values ('Säuregrad', defined as ml 0.1N NaOH/10 g sample required to reach pH 8.5) were: (i) 5.4, (ii) 5.4, (iii) 4.7, (iv) 8.8 and (v) 9.7. Further samples of (i) were adjusted to acidity values of 3.0, 4.9, 6.7 and 7.4. All bread samples were sliced, packaged in cellulose film and sterilized in steam, inoculated, and incubated at 8°, 15°, 20°, 23° and 30°C. At intervals, mould growth and ochratoxin A concn. were determined. Tables and graphs of results are given. None of the fungi grew on (iv) or (v). *Penicillium* sp. 386 did not grow on any bread. *Penicillium* sp. 384 did not grow on (i). Growth of *Asp. ochraceus* 6514 was enhanced by presence of linseed or wheat germ. Ochratoxin A was produced in measurable quantities only by *Asp. ochraceus* 6514. Growth of this strain was max. at acidity value 3.0, temp. 20°C. Acidity value had little effect on ochratoxin synthesis; the optimum temp. range for ochratoxin synthesis was 15–20°C. Max. ochratoxin A concn. recorded in the bread samples was 0.8 µg/g. it is concluded that hazardous levels of ochratoxin A may be formed in wholemeal wheat bread. AJDW

56

[Mycotoxins in food and their influence on human health.] [Review]

Gertig, H.; Szajkowski, Z.

Zywni Człowieka 6 (3) 143–149 (1979) [34 ref. Pl] [Zakładu Bromatologii Inst. Bioanalizy i Badania Środowiska AM, Poznań, Poland]

In this short review, aspects covered include mycotoxin occurrence; mycotoxin-producing strains; pathogenic effect and the LD₅₀ toxicity levels determined in animal trials; optimal synthesis conditions; and methods to prevent or inhibit mycotoxin formation. The most important data on toxicity, origin and effects (with references) are tabulated for 32 mycotoxins. IN

57

[Mycotoxin contamination of foods, with reference to maximum tolerances.]

Pantovic, D.; Adamovic, V. M.

Hrana i Ishrana 21 (7/8) 177–180 (1980) [22 ref. Sh, en] [Zavod za Zastitu Zdravlja SR Srbije, Belgrade, Yugoslavia]

666 samples of imported foods (wheat, corn, barley, oats, beans, rice, coffee, cocoa, dried fruit, almonds, hazelnuts, walnuts, groundnuts, and cashew nuts) collected over 4 yr were examined for aflatoxins (B₁ and G₁), ochratoxin and zearalenone. 26% (173) of samples contained aflatoxins B₁ and G₁, 22.9% containing ≤ 5 parts/billion (p.p.b.), 1.5% containing ≤ 10 p.p.b., and 1.5% containing > 10 p.p.b. 242 of the total samples were cereals; of these, 51.3% were contaminated with aflatoxins B₁ and G₁. Ochratoxin was not detected in any samples; zearalenone was detected only in 50% of the corn samples examined, at concn. of 0.25–2.6 p.p.m. The authors conclude that the current max. permissible concn. of aflatoxin B₁ and G₁ in cereals (of 1 p.p.b.) should be raised to 5 p.p.b. IN

58

[Formation of mycotoxins (ochratoxin) and their detoxification in cereal grains.]

Chelkowski, J.

Roczniki Akademii Rolniczej w Poznaniu Rozprawy Naukowe No. 100, 47pp. (1980) [132 ref. Pl, en, ru]

Influence of several factors such as cereal type and var. and native mycoflora on contamination of grain by mycotoxins, and effectiveness of detoxification methods were investigated. Commercial cereals contained up to 10³ fungal spores/g. *Aspergillus* and *Penicillium* spp. predominated in barley. Of 49 typical fungal isolates, 9 were toxinogenic. Major contamination was by ochratoxin A; citrinin, penicillic acid and sterigmatocystin were also found. Level of contamination varied from yr to yr, but general trend was for 5–7% of samples to be contaminated by

mycotoxins 2 months after harvest, with ochratoxin A content up to 140 µg/kg. Growth and ochratoxin A production was lower on sound viable kernels than on unviable grains. Variety had a marked influence on rate of fungal development for several var. of wheat, rye and barley. Wet or dry cleaning and sorting did not significantly reduce mycotoxin content of grain. Uniform distribution of ochratoxin A in bran and flour showed that milling would not produce detoxified flour from a contaminated grain. Ochratoxin content of barley was reduced by pearling. Detoxification of feed grain by treatment with aqueous NH₃ was also studied. [From En summ.] DIH

59

[Production of trichothecene mycotoxins of *Fusarium* species in wheat and barley harvested in Saitama Prefecture.]

Suzuki, T.; Kurisu, M.; Hoshino, Y.; Ichino, M.; Nose, N.; Tokumaru, Y.; Watanabe, A.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 21 (1) 43-49 (1980) [10 ref. Ja, en] [Saitama Inst. of Public Health, 639-1, Kamiookubo-higashi, Urawa-shi, Saitama, Japan]

Freshly harvested wheat and barley of the 1977 crop were examined for trichothecene mycotoxin contamination and for the presence of *Fusarium* sp. Trichothecenes such as deoxynivalenol, fusarenon-X, nivalenol, diacetoxyscirpenol, neosolaniol and T-2 toxin were not detected in these samples. The incidence of *Fusarium* contamination ranged from 0 to 32.7%. The most common sp. was *F. graminearum*, 73.7% of the total *Fusarium* isolates (810 strains) belonged to this sp., followed by *F. equiseti*, *F. oxysporum*, *F. semitectum* and *F. avenaceum* (8.0%, 5.6%, 3.3% and 3.3%, resp.). Frequencies of *F. tricinatum*, *F. poae*, *F. moniliforme*, *F. acuminatum*, *F. merismoides*, *F. solani* and *F. sulphureum* were very low in these samples. The occurrence of trichothecene-producing strains in the 179 isolates selected was 43%. Among 57 isolates of *F. graminearum*, 43 produced both nivalenol and fusarenon-X, and 4 produced deoxynivalenol. Several trichothecenes, such as nivalenol, fusarenon-X, diacetoxyscirpenol and neosolaniol, were produced simultaneously by 16 of 25 isolates of *F. equiseti* and 8 of 23 isolates of *F. semitectum*. 3 of 4 *F. acuminatum* produced both T-2 toxin and neosolaniol, and one of 5 *F. poae* also produced neosolaniol. AS

60

Enzyme-linked immunosorbent assay for detection of ochratoxin A.

Pestka, J. J.; Steinert, B. W.; Chu, F. S.

Applied and Environmental Microbiology 41 (6) 1472-1474 (1981) [12 ref. En] [Dep. of Food Microbiol.

& Toxicology, Univ. of Wisconsin-Madison, Madison, Wisconsin 53706, USA]

A simple microtest plate enzyme-linked immunosorbent assay was developed for the detection of ochratoxin A at levels as low as 25 pg/assay. The relative cross-reactivities of the antibody in this system with ochratoxin A (OA), OB, OC, and Oα were found to be 1.0, 0.14, 0.44, and 0.01, resp. AS

61

Effect of temperature cycling on the production of patulin and citrinin.

Lin, Y. C.; Ayres, J. C.; Koehler, P. E.

Journal of Food Science 46 (3) 974-975, 977 (1981) [13 ref. En] [Dep. of Food Sci., Univ. of Georgia, Athens, Georgia 30602, USA]

2 strains of *Penicillium urticae* (NRRL 2159A and 1952) and one strain of *P. citrinum* (NRRL 5927) were used to investigate the effect of temp. cycling on the production of patulin and citrinin. Temp. cycling (33-25°C, 33-15°C, and 25-15°C) delayed the rate of patulin biogenesis. As a general rule, cultures grown under cycling temp. conditions produced less patulin than cultures grown at constant temp. The effect of temp. cycling (30-25°C, 30-15°C, and 25-15°C) on citrinin production was found to vary with the temp. combination. IFT

62

[Changes in patulin content during concentrated apple juice production.]

Buchalla, B.

Konzerv-es Paprikaipar No. 1, 23-25 (1980) [23 ref.

- Hu, de, ru] [Kerteszeti Egyetem, Kecskemet, Hungary]

Laboratory examinations of the raw apples used showed that the rotten parts contained an average of 88.8 mg patulin/kg. Since the rotten parts constituted 20.8% of the apples and 5.63% of the rotting was caused by *Penicillium expansum*, the producer of patulin, the average patulin concn. of the raw material was 1.05 mg/kg. Examination of the various phases of apple juice production (pressing, straining, concn. etc.) showed that the process did not reduce the original patulin content significantly despite repeated heat treatments. ESK

63

[Toxin formation by mould microflora in barley.]

Chelkowski, J.; Dopierala, G.; Godlewska, G.; Radomyska, W.

Przemysł Fermentacyjny i Owocowo-Warzywny 23 (10) 10-11 (1979) [16 ref. Pl, ru, en, de] [Akademia Rolnicza, Poznan, Poland]

The predominant types of fungal microflora in brewer's barley during storage, and their toxin forming ability, were investigated. Mycotoxins were determined according to AOAC methods. Four mycotoxins were found, produced by *Aspergillus versicolor*, *A. repens* and *A. melleus*. Conditions for mycotoxin production are: presence of toxin-formers in the material, and suitable medium and environmental conditions. The practical conclusions are that grain should be treated immediately after harvesting and silos should be charged only with as much grain as can be dried to the desired moisture level in a short time. The development of mouldy odour or growth of mycelium on the grain may result in inferior technological properties and occurrence of mycotoxins. STI

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FAB 50

MYCOTOXINS IN FOODS (EXCLUDING AFLATOXINS & MICROBIAL TOXINS)

SELECTED FROM VOLUME **12**

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of

Commonwealth Agricultural Bureaux, Farnham Royal, Bucks; Gesellschaft für Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

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Food Annotated Bibliographies (FABs) are collections of abstracts on specific topics in food science and technology. The topics are chosen by the staff of the International Food Information Service as being of particular interest or importance. The topics normally interest individual workers, who may not require the full information provided in Food Science and Technology Abstracts, from which the abstracts for FABs are taken. The size and the cost of the FABs are controlled as much as possible with the interests of individual workers in mind.

Titles of the FABs now available are given on the back cover of this booklet. For up-to-date lists of FABs or suggestions for new topics please write to the address on the back cover. New subjects are searched for at least the five most recent volumes of Food Science and Technology Abstracts. Thereafter each FAB is updated monthly. Copies of each month's abstracts on any topic may be obtained as indicated on the back cover of this publication. At the end of each volume of up-dating, the abstracts are merged and made available as a separate supplement to the original FAB.

Some of the larger FABs have been divided into sections to facilitate use. FAB 47 also has a subject and author index provided.

Copies of all original articles referred to in the abstracts may be bought (or occasionally borrowed) from the International Food Information Service. A form for ordering these is provided at the end of this FAB.

Coverage of the subject has been restricted to that of Food Science and Technology Abstracts, which covers over 1200 of the important food journals, patents from 20 countries and books published world-wide. Every effort is made to include all significant references, but editorial discretion is used on the many articles of borderline interest. If the reader particularly needs an exhaustive search of the subject, we will be pleased to provide any other references that we have available. We would, in any case, encourage readers to write or telephone us with any comments or queries that they may have.

H. BROOKES

EDITOR

1

Biosynthesis of [^{14}C] patulin by *Penicillium urticae*.
Eisele, T. A.; Pierce, T. S.; Brannen, A. L.; Swanson, B. G.
Journal of Agricultural and Food Chemistry 27 (4)
905-906 (1979) [17 ref. En] [Dep. of Food Sci. & Tech.,
Washington State Univ., Pullman, Washington 99164,
USA]

2

[Toxicogenic moulds in food products ripened by selected mould strains.]

Preda, N.; Gabor, M.; Constantinescu, C.
Igiene 27 (3) 229-233 (1978) [10 ref. Ro, en, ru] [Inst. de
Med. & Farmacie, Cluj-Napoca, Romania]

Studies were conducted on growth of potentially
toxigenic moulds on salamis treated with a pure culture
of the ripening mould *Penicillium expansum*. The %
frequency of occurrence of moulds on the surface of the
sausages was: *P. expansum* 100; *P. viridiatatum* 2; *P.*
urticae 0.5; and *Cladosporium herbarium* 0.15. In
addition, the string used for suspension of the sausages
was contaminated with *Mucor hiemalis* in 32% and with
Rhizopus nigricans on 40% of occasions. None of the
strains isolated from the sausages were capable of
forming mycotoxins under sausage-ripening conditions.
The desirability of avoiding contamination with
toxigenic moulds in stressed. AJDW

3

**[Studies on effects of the bisulphite ion on the
mycotoxin patulin. I. Studies on aqueous solutions.]**
Untersuchungen über den Einfluss von
Hydrogensulfitionen auf das Schimmelpilzgift Patulin. I.
Versuche in wässrigen Lösungen.

Adam, R.; Koller, W. D.
Deutsche Lebensmittel Rundschau 75 (8) 254-256
(1979) [14 ref. De, en, fr] [Inst. für Lebensmittelchem.,
Bundesforschungsanstalt für Ernährung, 7500
Karlsruhe, Federal. Republic of Germany]

Studies were conducted on effects of pH and the
bisulphite ion on the stability of patulin in aqueous
solutions. Samples were prepared containing 100
parts/billion patulin dissolved in (i) neutral double-
distilled water; (ii) double-distilled water adjusted to pH
3.5 with HCl; or (iii) a solution containing 200 p.p.m. SO_2
in double-distilled water adjusted to pH 3.5. Patulin
concn. were determined by HPLC at intervals during
storage of (i) or (ii) samples for ≤ 160 days, or storage
of (iii) samples for ≤ 50 days. The results show patulin
concn. in (i) to decrease to approx. 50 % of the initial
value, and that in (ii) to decrease to approx. 60 % of the
initial value during storage for 160 days. In (iii), patulin
concn. decreased to ≤ 1 part/billion within
days. AJDW

4

**[Studies on the fluorescent compounds in fermented
foods. V. The behaviour of fungi during miso and
shoyu fermentation and aflatoxin inspection of
commercial shoyu.]**

Manabe, M.; Matsuura, S.
Report of the National Food Research Institute
[*Shokuryo Kenkyusho Kenkyu Hokoku*] No. 34,

79-83 (1979) [9 ref. Ja, en] [Nat. Food Res. Inst., Min. of
Agric., Forestry & Fisheries, Tokyo, Japan]

Effects of NaCl on the growth of fungi in koji culture
were tested by culturing *Aspergillus flavus*, *A.*
parasiticus, *A. versicolor*, *A. ochraceus*, *A. clavatus* and
Penicillium citreo-viride (selected as mycotoxin
producing fungi) and *A. oryzae* (as a useful food
fermentation organism). After one wk at 30°C all the
strains grew well in koji culture media containing
0-12% NaCl, but none grew in media containing $\geq 15\%$
NaCl. To test the possibility of mycotoxin production
during fermentation of miso and shoyu, the growth of
the fungi was investigated. Most of the fungi present
were *A. oryzae*, and they were immediately inactivated
in the fermentation mixtures due to the high salt levels,
which seemed to rule out the possibility of mycotoxin
contamination of the products. An inspection of 39
samples of commercial shoyu from various Japanese
prefectures did not reveal a single instance of aflatoxin
contamination. [From En summ.] JRR

5

**Influence of temperature on the strain of *Fusarium*
graminearum Schwabe in zearalenone production.**

Naik, D. M.; Busch, L. V.; Barron, G. L.
Canadian Journal of Plant Science 58 (4) 1095-1097
(1978) [4 ref. En] [Dep. of Environmental Biol., Univ. of
Guelph, Guelph, Ontario N1G 2W1, Canada]

Evidence suggests that zearalenone is produced
largely after harvest, especially in maize in cribs.
5 strains of *Fusarium graminearum* isolated from maize
in Ontario were evaluated for zearalenone production
relative to incubation temp. (10°, 15°, 20°, 25° and 30°C).
The production of zearalenone in colonized kernels was
influenced by both temp. and strain used. Strains 1, 2
and 7 produced much greater amounts of toxin than
strains 4 or 6. The 3 highest yielding strains produced as
much zearalenone at a constant temp. of 25°C as at any
other combination of temp. tested. Strain 4 was the only
one of the 5 isolates that reacted to a temp. stress (25°C
reduced to 10°C), while strain 6 produced greater
amounts of the toxin with a temp. rise. It was concluded
that in Ontario, physiologically significant amounts of
zearalenone can be produced at any temp. from 10° to
30°C and it is not possible to make meaningful
predictions or recommendations based on prevailing
post-harvest temp. VJG

6

**Ochratoxin A contamination of foodstuffs in an area
with Balkan (endemic) nephropathy.**

Pavlovic, M.; Plestina, R.; Krogh, P.
Acta Pathologica et Microbiologica Scandinavica, B
87 (4) 243-246 (1979) [14 ref. En] [Dep. of Toxicology,
Inst. for Med. Res. & Occupational Health, Zagreb,
Yugoslavia]

Samples of locally produced cereals and wheat bread
were collected over a 5-yr period from individual
homes in a village (in Croatia) where 7.3% of the
population were affected by Balkan (endemic)
nephropathy. Samples were analysed for frequency of
contamination of ochratoxin A using a TLC method
having a detection limit of 5 μg . Products analysed, with
number of samples in parentheses, mean frequency of
contamination for the overall period and the range of

yearly values are as follows: maize (542), 8.3%, 0–15.2%; wheat (130), 8.5%, 0–25.0%; wheat bread (32), 18.8%, 6.7–29.4% (2 yr only); and barley (64), 12.5%, 0–42.9%, (3 yr only). Results show wide variation from yr to yr, and generally very high frequencies of contamination. Quantitative detn. performed on some samples showed that 10% of contaminated maize sample had > 100 µg ochratoxin A/kg, vs. 33% of contaminated wheat samples. 3 contaminated barley samples contained 13.5–25.6 µg/kg. Further studies are required on the possible role of ochratoxin A as a disease determinant of Balkan (endemic) nephropathy. No ochratoxin other than ochratoxin A was detected in any of the samples. DIH

7

[Contamination of cheeses by mycotoxins.]

Lafont, P.; Siriwardana, M. G.; Lafont, J.

Medecine et Nutrition 15 (4) 257–262 (1979) [20 ref. Fr, en] [INSERM, 44 Chemin de Ronde, 78110 Le Visinet BP 40, France]

Examination of 235 samples of different types of cheeses for the presence of mycotoxins showed that of 110 samples of blue-veined cheese, 41 contained 0.01–15 p.p.m. mycophenolic acid and 1 contained 0.82 p.p.m. penicillic acid; no aflatoxins, sterigmatocystin or patulin were detected. In 48 hard cheeses, sterigmatocystin and penicillic acid were each present in 3 samples, mycophenolic acid in 4 samples and patulin in 1 sample; mycotoxins were mainly present in the crust of hard cheese. No mycotoxins could be detected in 20 soft cheeses. Examination of 39 pressed cheeses with surface moulds showed that 7 contained 0.01–5.0 p.p.m. mycophenolic acid, 5 contained a trace–0.71 p.p.m. penicillic acid and 4 contained 0.045–0.355 p.p.m. patulin. One out of 19 samples of goats' milk cheese contained 0.03 p.p.m. patulin and 2 samples contained 0.045 and 0.210 p.p.m. penicillic acid. 19 moulds capable of synthesizing mycotoxins were isolated from the surfaces of 24 cheese in which mycotoxins were detected. The amounts of mycotoxins produced by these moulds, when grown in a modified Czapek medium, ranged from 16 to 42 mg sterigmatocystin, 0.3–1.1 g patulin and 0.36–0.95 g penicillic acid/l. Causes of contamination of cheeses with mycotoxins are discussed. MEG

8

[Moulds and mycotoxins.]

Nilsson, G.

Livsmedelsteknik 21 (2) 70–72 (1979) [Sv]

This survey of the situation in Sweden with regard to moulds and mycotoxins in foods covers methods of analysis and control, aflatoxin, ochratoxin, patulin and work in progress in Sweden on the topic. Results of analyses of foods carried out by the Swedish Food Authority (Statens Livsmedelsverk, SLV) are given briefly, showing proportions of samples of nuts, flour and dough (examined during 1973–1978) exceeding the Swedish legal limit (0.005 mg/kg) for aflatoxin; % of samples of grain, peas, beans and kidneys found positive for ochratoxin A; and % of samples of apple-based drinks, fruits, grain, peas and beans found positive for patulin. HBr

9

Mutagens in the Nigerian environment.

Uwaifo, A. O.; Emerole, G. O.; Bababunmi, E. A.; Bassir, O.

Toxicology and Applied Pharmacology 45 (1) 223 (1978) [En] [Univ. of Ibadan, Ibadan, Nigeria]

Previous studies had indicated that many Nigerian foods are heavily contaminated with toxigenic fungi such as *Aspergillus flavus*. In view of this fact, studies were made of the mutagenicity (to *Salmonella typhimurium*) of various metabolites of *Asp. flavus*. This paper reports on the mutagenicity of 2 metabolites, palmotoxin B₀ and G₀, from *Asp. flavus* isolated from palm sap, an alcoholic beverage popular in Nigeria. The studies indicated that, although palmotoxin B₀ and aflatoxin B₁ have comparable toxicity profiles, palmotoxin B₀ is only one-eighth as mutagenic as aflatoxin B₁. Palmotoxin G₀ has a lower toxicity than palmotoxin B₀. Neither palmotoxin seems to be a frameshift mutagen, in contrast to aflatoxins. JA

10

[Chromatographic method for determination of aflatoxins B and G and ochratoxin A in foods.]

Cirilli, G.; Cantafora, A.; Bonora, S.; Angeli, A. degli
Rivista della Societa Italiana di Scienza dell'Alimentazione 8 (3) 201–206 (1979) [19 ref. It] [Univ. Int. G. Galilei, Bologna, Italy]

A procedure for detn. of aflatoxins and ochratoxin A in foods is described, based on extraction with distilled water/acetone (3:10 v/v), filtration of the extract, evaporation of the solvent, dissolving the residue in chloroform/hexane (1:3 v/v), clean-up by column chromatography on silica gel (elution of aflatoxins with chloroform/methanol 96:4, elution of ochratoxin with benzene/acetic acid 90:10), and separation by TLC on silica gel, using a toluene/ethyl acetate/formic acid (60:32:8) solvent system. Mycotoxin flecks may be identified by UV fluorescence and determined by fluorodensitometry. Comparative trials on spiked samples of various foods showed the new method to agree well with the EEC method; recovery values of the new method were high and consistent. Detection limit was 0.005 p.p.m. for aflatoxin B₁, 0.010 p.p.m. for the other aflatoxins, and 0.020 for ochratoxin A. AJDW

11

Mycotoxins I and II. [Conference proceedings]

United States of America, American Oil Chemists Society

Journal of the American Oil Chemists' Society 56 (9) 783–829 (1979) [many ref. En]

Papers presented at the 69th meeting of the American Oil Chemists Society held at St. Louis, Missouri, are given, and include: The three eras of fungal toxin research, by L. Stoloff (pp. 784–788, 42 ref.); Field contamination of corn in South Georgia, by D. M. Wilson, W. W. McMillian & N. W. Widstrom (pp. 798–799, 18 ref.); Decontamination of corn containing aflatoxin by treatment with ammonia, by E. B. Bagley (pp. 808–811, 13 ref.); Zearalenone in cereal grains, by G. A. Bennett & O. L. Shotwell (pp. 812–819, 72 ref.); and Trichothecenes: natural occurrence and potential hazards, by S. V. Pathre & C. J. Mirocha (pp. 820–823,

47 ref.). A further 4 papers are abstracted separately in FSTA and are listed in the author index under **United States of America**, American Oil Chemists Society [Mycotoxins Symposium]. SP

12

Mycotoxins - their biosynthesis in fungi. [Conference proceedings]
United States of America, American Society for Microbiology
Journal of Food Protection 42 (10) 804-835 (1979)
[many ref. En]

6 papers presented at a seminar held during the 78th Annual Meeting of the American Society for Microbiology, May, 1978, in Las Vegas, Nevada, USA, are published, following a general introduction, by D. P. Hsieh (p. 804, 9 ref.). The 6 titles are listed as follows. Aflatoxins and other bisfuranoids, by J. W. Bennett & L. S. Lee (pp. 805-809, 82 ref.). Patulin and related carcinogenic lactones, by G. M. Gaucher (pp. 810-814, 40 ref.). Ochratoxins - metabolites of combined pathways, by W. E. Huff & P. B. Hamilton (pp. 815-820, 25 ref.). Zearalenone biosynthesis, by C. J. Mirocha & S. V. Pathre (pp. 821-824, 11 ref.). Biosynthesis of the trichothecenes, by A. Ciegler (pp. 825-828, 26 ref.). Ergot alkaloids, by J. E. Robbers (pp. 829-835, 42 ref.). DIH

13

[Cell-culture assay for detection of mycotoxins. I. Investigations with pure toxins.] Ein Zellkulturtest für den Nachweis von Mykotoxinen. I. Untersuchungen an Reinsubstanzen.
Lompe, A.; Milczewski, K.-E. von
Zeitschrift für Lebensmittel-Untersuchung und -Forschung 169 (4) 249-254 (1979) [40 ref. De, en]
[Miles-Kalichemie GmbH + Co KG, Grosse Drakenburgerstr. 103, D-3070 Nienburg, Federal Republic of Germany]

For detection of mycotoxins by a biological assay cells were seeded in Microtiter-plates together with toxin. After 24 h and 6 days of culture cells were examined visually for cytotoxic effects, growth inhibition, and morphological aberrations. 3 human and 2 porcine cell-lines were compared as to their reaction with 16 mycotoxins and 9 organic chemicals. Results indicate that sensitivity to toxins was partially dependent on type and origin of cells. This suggests the use of several selected cell-lines in parallel for testing of microbially derived food additives for possible contamination by mycotoxins. AS

14

Trichothecenes and their analysis. [Lecture]
Eppley, R. M.
Journal of the American Oil Chemists' Society 56 (9) 824-829 (1979) [35 ref. En] [Div. of Chem. & Physics, FDA, Washington DC 20204, USA]

The analysis of foods for the naturally occurring *Fusarium* produced trichothecenes is reviewed. Each major step (extraction, purification and detection-quantitation) is discussed. Although none of the extraction solvents has been thoroughly evaluated,

aqueous methanol is the preferred system in most of the published procedures. The sample extracts are generally purified by liquid-liquid partitions followed by silica gel column and/or preparative TLC. Both TLC and GLC are used for the detection and quantitation of the trichothecenes. The detection limit for the GLC procedures has not been determined in most of the reported methods; however, T-2 toxin, diacetoxyscirpenol, deoxynivalenol, and neosolaniol have been detected in the 25-100 ng/g range. [See FSTA (1980) 12 3C97.] AS

15

Production of [³H] patulin of high specific activity.
Gillespie, T. J.; Price, R. L.
Food and Cosmetics Toxicology 17 (1) 55-59 (1979)
[20 ref. En] [Dep. of Nutr. & Food Sci., Univ. of Arizona, Tucson, Arizona 85721, USA]

16

Toxins of molds from decaying tomato fruit.
Harwig, J.; Scott, P. M.; Stoltz, D. R.; Blanchfield, B. J.
Applied and Environmental Microbiology 38 (2) 267-274 (1979) [46 ref. En] [Health & Welfare Canada, Tunney's Pasture, Ottawa, Ontario, Canada K1A 0L2]

Among 27 mould isolates from decaying tomatoes, culture filtrates or ethyl acetate extracts of 8 isolates grown in yeast extract-sucrose medium were markedly toxic (mortality > 50%) to brine shrimp larvae. The toxicity of 6 of these isolates could be attributed to the presence of citrinin, tenuazonic acid, or T-2 toxin. Ethyl acetate extracts of 5 *Alternaria* isolates and 1 *Fusarium* isolate were mutagenic for *Salmonella typhimurium* strains. In ripe tomatoes inoculated with toxin-producing isolates and incubated at 25°C, 1 *Alternaria alternata* isolate produced tenuazonic acid in 7 of 7 tomatoes at levels of up to 106 µg/g and alternariol methyl ether in 1 of the 7 tomatoes at 0.8 µg/g. Another *A. alternata* isolate produced tenuazonic acid or alternariol methyl ether at much lower levels in only 3 of 7 tomatoes. Patulin and citrinin were produced by a *Penicillium expansum* isolate at levels of up to 8.4 and 0.76 µg/g, resp. In tomatoes incubated at 15°C, a *Fusarium sulphureum* isolate produced T-2 toxin, HT-2 toxin, and neosolaniol at levels of up to 37.5, 37.8, and 5.6 µg/g, resp. If these mycotoxins are thermostable, they may occur at detectable levels in tomato products whenever partially mouldy tomatoes are used as raw material. AS

17

Sample preparation of some shelled tree nuts and peanuts in a vertical cutter-mixer for mycotoxin analysis.

Francis, O. J., Jr.
Journal of the Association of Official Analytical Chemists 62 (5) 1182-1185 (1979) [5 ref. En] [FDA, 4298 Elysian Fields Avenue, New Orleans, Louisiana 70122, USA]

A procedure was devised for more rapid preparation of large samples of nutmeats (10-80 lb) for mycotoxin analysis without the use of grinding aids, by combining

the grinding and mixing steps into one operation. Ease of cleaning equipment facilitates the preparation of several samples in a short time. The procedure was tested using shelled raw and roasted peanuts, and raw almonds, walnuts, and pecans. Reduction of particle size to pass a 20 mesh screen was attained using a 25 qt Hobart vertical cutter-mixer (VCM) equipped with standard serrated blades and a 40 qt VCM using either a standard serrated blade or a smooth-edge blade modified with sharp-edge notches to increase its cutting ability. Portions of ground composite were removed at various time intervals and particle sizes were measured. Original and check analyses of 12 naturally contaminated samples over a 3 yr period indicate that this procedure is practical and reproducible. AS

18

High pressure liquid chromatographic determination of ochratoxin A and zearalenone in cereals.

Josefsson, E.; Möller, T.

Journal of the Association of Official Analytical Chemists 62 (5) 1165-1168 (1979) [14 ref. En] [Swedish Nat. Food Administration, Food Lab., S-751 26 Uppsala, Sweden]

An HPLC method was developed for determining ochratoxin A and zearalenone in cereals. The sample is extracted with phosphoric acid and chloroform. The extract is cleaned by washing on a silica gel column with cyclohexane/ethylene dichloride/ethyl ether. After eluting zearalenone with chloroform, ochratoxin A is eluted with chloroform/formic acid. Zearalenone is extracted into alkaline solution, washed with chloroform, the pH is adjusted, and the zearalenone is extracted back into chloroform. Ochratoxin A is purified by chromatography on aqueous sodium bicarbonate/Celite. The mycotoxins are determined by using a liquid chromatograph with 2 columns in series packed with Spherisorb ODS 10 μ m and 5 μ m, resp. Ochratoxin A is detected with a spectrophotofluorometer, coupled in series with a UV detector for estimation of zearalenone. Detection limits are 1-5 μ g/kg for ochratoxin A and 2 μ g/kg for zearalenone. AS

19

Incidence of *Fusarium* species and the mycotoxins, deoxynivalenol and zearalenone, in corn produced in esophageal cancer areas in Transkei.

Marasas, W. F. O.; Rensburg, S. J. van; Mirocha, C. J. *Journal of Agricultural and Food Chemistry* 27 (5) 1108-1112 (1979) [31 ref. En] [Nat. Res. Inst. for Nutr. Diseases, South African Med. Res. Council, Tygerberg 7505, South Africa]

The highest known oesophageal cancer rate in Africa occurs in the southwestern districts of the Transkei, while the rate in the northeastern region of the country is relatively low. Corn is the main dietary staple in both areas. 3 spp. of *Fusarium*, i.e., *F. graminearum*, *F. verticillioides* (= *F. moniliforme*) and *F. sacchari* var. *subglutinans* (= *F. moniliforme* var. *subglutinans*) were isolated from corn kernels from both areas. 2 *Fusarium* mycotoxins, deoxynivalenol and zearalenone, were detected at biologically significant levels (250-4000 and

1500-10 000 μ g/kg, resp.) in hand-selected, visibly *Fusarium*-infected corn kernels from both areas. The level of natural contamination of corn kernels with both mycotoxins was considerably higher in the high-incidence area of oesophageal cancer than in the low-incidence area. The validity of this difference could not be tested because only a small number of pooled samples were analysed. AS

20

Relationship of mycotoxins to human diseases.

Hayes, A. W.

Abstracts of the Annual Meeting of the American Society for Microbiology 79, 31 (1979) [En] [Univ. of Mississippi Med. Cent., Jackson, Mississippi, USA]

At least 9 human diseases have been suggested to involve mycotoxins in their aetiology. 3, hepatocellular carcinoma, Reye's syndrome and Balkan nephropathy, are discussed. Data suggest a link between aflatoxin and the first 2 whereas ochratoxin A or ochratoxin A + citrinin or an unknown *Aspergillus* toxin are possible aetiological agents for Balkan nephropathy. Epidemiologic studies show a high correlation between ingestion of aflatoxin-contaminated food and primary liver cancer. These data, coupled with the fact that aflatoxin is a potent carcinogen in animals, support its involvement in human liver cancer. Data also suggest the association of aflatoxin B₁ with Reye's syndrome, a disease of unknown aetiology which kills young children, in New Zealand, Czechoslovakia, Thailand and the USA. Although evidence supporting a mycotoxin aetiology for Balkan nephropathy, endemic to the Danube River basin of Romania, Bulgaria and Yugoslavia, is less convincing, the presence of ochratoxin A and a 2nd toxigenic fungus in plate samples suggests such an aetiology. In addition, clinical symptoms reported for avian and porcine mycotoxic nephropathy, induced by ochratoxin A and/or citrinin, resemble Balkan nephropathy. AS

21

The kidney and ochratoxin A.

Cooper, P.

Food and Cosmetics Toxicology 17 (4) 406-408 (1979) [14 ref. En] [British Ind. Biol. Res. Ass., Woodmansterne Rd., Carshalton, Surrey, UK]

Recent work on Balkan (or endemic) nephropathy, a disease characterized clinically by renal failure, is reviewed. Consideration is given to certain nephrotoxic fungi that contaminate human foodstuffs as possible causes of the disease. Effects of ochratoxin A, a secondary metabolite of some *Aspergillus* and *Penicillium* spp., are shown to resemble those seen in Balkan nephropathy. VJG

22

In vitro metabolism of [¹⁴C] rubratoxin B by rat hepatic subcellular fractions.

Unger, P. D.; Siraj, M. Y.; Hayes, A. W.

Food and Cosmetics Toxicology 17 (2) 111-116 (1979) [13 ref. En] [Dep. of Pharmacy & Toxicology, Univ. of Mississippi Med. Cent., Jackson, Mississippi, USA]

The metabolism of rubratoxin B, a hepatotoxic metabolite of the fungi *Penicillium rubrum* and *P. purpurogenum*, was studied in vitro using rat hepatic subcellular fractions. Results indicated that the transformation of rubratoxin B was most active in the microsomal supernatant fraction, the transformation being primarily non-enzymic. VJG

23

Inhibitory action of the mycotoxins patulin and penicillic acid on urease.

Reiss, J.

Food and Cosmetics Toxicology 17 (2) 145-146 (1979) [11 ref. En] [Mikrobiol. Lab., Grahamhaus Studt KG, D-6550 Bad Kreuznach, Federal Republic of Germany]

24

Patulin in apple juice from roadside stands in Wisconsin.

Brackett, R. E.; Marth, E. H.

Journal of Food Protection 42 (11) 862-863 (1979)

[11 ref. En] [Dep. of Food Sci., Univ. of Wisconsin-Madison, Madison, Wisconsin 53706, USA]

Apple juice was purchased from roadside stands in Wisconsin in 1976 and 1977 and analysed for patulin with an HPLC method having a limit of detection of 10 µg/l. In 1976 2 of 11 samples, and in 1977, 15 of 29 samples, had < 10 µg patulin/l. Average contents of patulin (µg/l) in 1976, 1977 and of all 40 samples (with s.d. in parentheses) were 115.2 (121.5), 26.0 (45.3) and 50.7 (83.2) resp. Of the 40 samples, 29 contained ≤ 50 µg patulin/l. DIH

25

Ascorbic acid and ascorbate cause disappearance of patulin from buffer solutions and apple juice.

Brackett, R. E.; Marth, E. H.

Journal of Food Protection 42 (11) 864-866 (1979)

[15 ref. En] [Dep. of Food Sci., Univ. of Wisconsin-Madison, Madison, Wisconsin 53706, USA]

HPLC was used to measure patulin in studies on the effect of ascorbic acid or ascorbate on stability of the mycotoxin. First, patulin was added to give a final concn. of 5000 µg/l of buffer at pH 7.5 and 25°C to which 2% (w/v) of sodium ascorbate was added at Day 0 or Day 6. The rate of disappearance of patulin increased immediately after addition of ascorbate. Second, patulin was added to give a final concn. of 5000 µg/l in a buffer at pH 3.5 and 25°C to which 3, 1, 0.5, 0.15 or 0% (w/v) of an ascorbic acid: ascorbic mixture (Vit C) was added. The amount of patulin decreased at a faster rate in samples which contained Vit C than in the control samples without Vit C. Rates of disappearance of mycotoxin increased with increasing concn. of Vit C. Third, patulin was added to give a final concn. of 300 µg/l in samples of apple juice to which 5 and 0% Vit C was added. Samples were held at 10°C throughout the experiment. Patulin disappeared from apple juice when Vit C was present, but the mycotoxin was quite stable in its absence. AS

26

Mycophenolic acid in marketed cheeses.

Lafont, P.; Siriwardana, M. G.; Combemale, I.; Lafont, J. *Food and Cosmetics Toxicology* 17 (2) 147-149 (1979) [14 ref. En] [Unite de Toxicology Alimentaire de l'INSERM, 44 Rue du Chemin de Ronde, 78110 Le Vesinet, BP 40, France]

Analyses were carried out on 100 samples of commercially marketed brands of the following cheeses (number of samples in parentheses): (i) Gorgonzola (12); (ii) German blue cheese (12); (iii) Tilsit (6); (iv) Stilton (5); (v) Roquefort (25); (vi) Bleu des Causses (6); (vii) Bleu d'Auvergne (8); (viii) Fourme d'Ambert (9); (ix) industrial French cheeses (15); and (x) melted cheese, Roquefort (2). Results showed that 38 contained mycophenolic acid. The proportion of samples contaminated varied with the type of cheese. (v) showed the highest incidence, with 84% affected, while contamination was rare in other types. None was detected in (vii), (viii), (iii), and (iv) samples. Number of samples of (v) contaminated with mycophenolic acid at a level between 0.01 and 0.1, 0.1 and 1, 1 and 5, 5 and 10, and 10 and 15, resp., was: 1, 2, 10, 5, 3. The relation between the mycophenolic acid level in cheese and in vitro production of the metabolite by *Penicillium roqueforti* isolates was investigated. In no case did cultures obtained from cheeses in which no mycophenolic acid was found produce > 0.040 mg mycophenolic acid/g dry wt. of culture. All cultures producing > 1 mg/g came from cheeses with mycophenolic acid levels > 1 p.p.m. This contamination is therefore due to the use during cheese manufacture of those *P. roqueforti* strains that produce a high yield of mycophenolic acid in vitro. VJG

27

The 'carry-over' of aflatoxin, ochratoxin and zearalenone from naturally contaminated feed to tissues, urine and milk of dairy cows.

Shreeve, B. J.; Patterson, D. S. P.; Roberts, B. A.

Food and Cosmetics Toxicology 17 (2) 151-152 (1979) [8 ref. En] [Cent. Vet. Lab., Weybridge, Surrey KT15 3NB, UK]

Concentrate rations containing 385-1925 µg zearalenone/kg or 317-1125 µg ochratoxin A/kg were prepared from naturally moulded wheat and barley, and were fed to 2 adult Jersey milking cows (individually 10 kg daily), the zearalenone ration for 7 wk and the ochratoxin ration for 11 wk before slaughter. All batches of both mixes were found to contain aflatoxin B₁ at a concn. of 20 µg/kg. Milk yield was recorded daily and milk samples were collected during the last wk of the feeding period. There was no obvious effect on milk yields. Residues of zearalenone, ochratoxin α and aflatoxin B₁ were not detected in muscle, liver, kidney, serum, milk or urine, but ochratoxin A was detected in the kidneys of 1 cow at a concn. of about 5 µg/kg and aflatoxin M₁ was detected in the kidneys, urine and milk of all animals at concn. varying from trace amounts to 0.6 µg/kg. VJG

28

Resolution of *Penicillium roqueforti* toxin and eremofortins A, B, and C by high-performance liquid chromatography.

Moreau, S.; Masset, A.; Biguet, J.

Applied and Environmental Microbiology 37 (6) 1059-1062 (1979) [7 ref. En] [INSERM U.42 Domaine du Certia, 59650 Villeneuve d'Ascq, France]

29

Excretion and tissue distribution of radioactivity from tritium-labeled T-2 toxin in chicks.

Chi, M. S.; Robison, T. S.; Mirocha, C. J.; Swanson, S. P.; Shimoda, W.

Toxicology and Applied Pharmacology 45 (2) 391-402 (1978) [20 ref. En] [Dep of Anim. Sci. & Plant Pathology, Univ. of Minnesota, St. Paul, Minnesota 55108, USA]

Broiler chicks were fed a standard diet until 1 wk of age and were then fed a diet containing 0, 0.5, 2.0 or 8.0 p.p.m. non-radioactive T-2 toxin (a metabolite of *Fusarium tricinctum*) until 6 wk of age. Some of the birds fed the diet containing 2.0 p.p.m. toxin were then intubated into the crop with tritium-labelled T-2 toxin in a single dose of 0.5 mg/kg body wt. and sacrificed 0.5, 4, 8, 12, 24 and 48 h after dosing. Other birds fed diets containing 0.5 and 8.00 p.p.m. toxin were similarly intubated with, resp., 0.126 and 1.895 mg tritium-labelled T-2 toxin/kg body wt. and sacrificed 24 h after dosing. Studies were made of the excretion and distribution of radioactivity in the chicks. Abdominal fat and heart contained the least amount of radioactivity. Radioactivity from the labelled toxin reached a max. 4 h after dosing in most tissues except muscle, skin and bile where the max. was reached after 12 h. The edible portions of the carcasses contained 0.06 and 0.04 p.p.m. T-2 toxin (or its metabolites) 24 and 48 h, resp., after dosing with 0.5 mg labelled toxin/kg body wt. Results indicated that the toxin and/or its metabolites are excreted into the intestine via the bile and that the liver is the major organ for excretion. JA

30

Inhibitory effects of spices on the growth and toxin production of toxigenic fungi.

Hitokoto, H.; Morozumi, S.; Wauke, T.; Sakai, S.

Abstracts of the Annual Meeting of the American Society for Microbiology 79, 204 (1979) [En] [Tokyo Metropolitan Res. Lab. of Public Health, Tokyo]

Inhibitory effects of 38 kinds of commercial powdered spices on growth and toxin production of *Aspergillus flavus* and *A. versicolor* were observed by introducing these substances into culture media for mycotoxin production. Of the 38 samples tested, cloves, star anise seeds, and allspice completely inhibited fungal growth, while the others only inhibited toxin production. The extracts from cloves and thyme completely inhibited the growth of both *A. flavus* and *A. versicolor* at 0.4 mg/ml or below. At a concn. of 2 mg/ml, extracts from star anise seeds showed inhibitory effect on growth of the strains. AS

31

Production and analysis of citrinin in corn.

Jackson, L. K.; Ciegler, A.

Applied and Environmental Microbiology 36 (3) 408-411 (1978) [18 ref. En] [N. Reg. Res. Cent., USDA, Peoria, Illinois 61604, USA]

A convenient method for the production and analysis of citrinin in corn is described. Up to 2.964 g of citrinin can be produced by *Penicillium citrinum* per kg of corn by harvesting on day 21 or later. The analysis method has a detection limit of 0.25 p.p.m. Heating citrinin-contaminated corn destroys citrinin but may produce another toxin instead. AS

32

[Qualitative and quantitative determination of two 12-13 epoxytrichothecenes (T₂ toxin and diacetoxyscirpenol) by GLC.]

Milama, N.; Lelieure, H.

Analusis 7 (5) 232-235 (1979) [10 ref. Fr, en] [Inst. de Recherches sur le Cancer, 7 rue Guy-Moquet, F-94800 Villejuif, France]

GLC methods were developed for detn. of 2 toxic metabolites of some microscopic fungi including food contaminants (i.e. *Fusarium*, *Trichothecium*, *Trichoderma*, *Myrothecium* and *Stachybotrys* sp.), T₂ toxin and diacetoxyscirpenol (DAS). Limits of detection for T₂ toxin and DAS, resp., are 250 and 150 parts/billion (p.p.b.) by flame ionization detection of trimethylsilyl derivatives, and 0.9 and 0.3 p.p.b. by electron capture detector with heptafluorobutyl imidazole derivatives. More information on these and other toxins could be obtained by alkaline hydrolysis prior to derivatization. RM

33

Antimicrobial action of roquefortine.

Kopp, B.; Rehm, H. J.

European Journal of Applied Microbiology and Biotechnology 6 (4) 397-401 (1979) [En] [Inst. für Mikrobiologie, Univ. Münster, Tibusstrasse 7-15, D-4400 Münster, Federal Republic of Germany]

Strains of bacteria occurring in Blue cheese (either as starters or as contaminants) were cultured in liquid nutrient medium in the presence of pure roquefortine extracted from *Penicillium roqueforti* ATCC 10110. Growth of bacteria was judged by protein detn. of 8 day cultures, and compared with controls grown without roquefortine. The growth of the Gram-negative organisms studied (enterobacteria and pseudomonads) was not influenced by 0.1 mg roquefortine/ml medium. The growth of *Lactobacillus helveticus*, *L. lactis*, *L. plantarum*, *Streptococcus thermophilus*, *Str. lactis*, *Str. cremoris*, and *Clostridium* spp. was impaired by presence of roquefortine, but growth of haemin-containing Gram-positive organisms including *Micrococcus caseolyticus*, *M. luteus* and *Bacillus* spp. was completely inhibited. JMa

34

Studies on the occurrence of ochratoxins in foodgrains.

Rati Rao, E.; Basappa, S. C.; Murthy, V. S.

Journal of Food Science and Technology, India 16 (3) 113-114 (1979) [9 ref. En] [Cent. Food Tech. Res. Inst., Mysore-570 013, India]

Food grains and oilseeds (180 samples) collected in Mysore City (India) were analysed for ochratoxin content. Ochratoxin contents (parts/billion) determined in various samples were: corn, 30-50; wheat, 30-50; sorghum, 50-70; groundnut seed, 50-2000; and ragi, 70. No ochratoxin was detected in rice, coffee and pulses. CFTRI

35

[Food hygienic aspects of the confectionery industry.] Hopko, I.

Edesipar 30 (1) 8-13 (1979) [4 ref. Hu, de]

The microflora of confectionery products, such as sweets, jellies, sweetmeats, marzipans, nougats, chocolates, biscuits, wafers and lipid-rich products, consists mainly of aerobic sporeforming bacilli (e.g. *Bacillus subtilis*, *B. cereus*) and fungi (e.g. *Penicillium* and *Aspergillus* spp.). The main factors affecting the microflora are storage temp. and RH. In groundnut-containing products aflatoxin may be present. Among the 8 aflatoxins produced by *Aspergillus flavus*, aflatoxin B₁ is the most toxic (10 mg daily may cause serious liver damage). The other commonly occurring mycotoxins are also tabulated. The most obvious changes during unfavourable storage are rancidity, fermentation, crystallization and surface cracking. For confectionery storage, the optimum temp. is about 16-18°C without sudden changes. The RH of the air of the storage place should be close to the equilibrium RH of stored products. The hygienic control of confectionery production and transport is discussed in detail. ESK

36

Reversed-phase high performance liquid chromatography determination of ochratoxin A in flour and bakery products.

Osborne, B. G.

Journal of the Science of Food and Agriculture 30 (11) 1065-1070 (1979) [28 ref. En] [Flour Milling & Baking Res. Ass., Chorleywood, Rickmansworth, Herts. WD3 5SH, UK]

Samples are extracted and purified by the method of Roberts & Patterson [see FSTA (1976) 8 6C279] followed by further clean-up by back extraction of the toxin into NaHCO₃ and re-extraction into chloroform after acidification. The extracts are chromatographed using a Lichrosorb RP8 10 µm column and mobile solvent, 55% acetonitrile in 0.1% aqueous H₃PO₄ at a flow rate of 1 ml/min. The height equivalent to a theoretical plate under these conditions is 0.08 mm, the average recovery is 46% and the overall sensitivity of the method is 0.5-1.0 µg/kg. When the toxin was added to flour samples which were subsequently baked into bread it was recovered without decomposition; when the experiment was repeated with biscuit baking however, about 2/3 of the toxin was destroyed or immobilized. AS

37

[Mycotoxins in foods. VIII. Analytical procedure of trichothecene mycotoxins in cereals.]

Kamimura, H.; Nishijima, M.; Saito, K.; Takahashi, S.; Ibe, A.; Ochiai, S.; Naoi, Y.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 19 (5) 443-448 (1978) [16 ref. Ja, en] [Tokyo Metropolitan Res. Lab. Public Health, Hyakunin-cho 3-chome, Shinjuku-ku, Tokyo, Japan]

Methanol extracts from cereal foods were concentrated and treated with Amberlite XAD-2 and Florisil columns. Trichothecene mycotoxins contained in the eluate were silylated, and then analysed by gas chromatography. The detection limit by the proposed analytical method was 0.1 p.p.m. of the mycotoxins. No trichothecene mycotoxin was detected in 42 commercial samples of wheat, barley, rice, corn, buckwheat and processed cereal foods. TM

38

Determination of ochratoxin A in pig's kidney using enzymic digestion, dialysis and high-performance liquid chromatography with post-column derivatisation.

Hunt, D. C.; Philp, L. A.; Crosby, N. T.

Analyst 104 (1245) 1171-1175 (1979) [21 ref. En] [Lab. of the Gov. Chem., Cornwall House, Stamford Street, London SE1 9NQ, UK]

A method for detn. of ochratoxin A in pig's kidneys is described. The detection limit is < 1 µg/kg. By using enzymic digestion concurrently with dialysis and by controlling the pH-conditions, the sample is extracted and interfering co-extracts removed without the use of column chromatography. The final detn. employs reversed-phase HPLC with either a phthalimidopropylsilane or a C₂₂ (docosyl) bonded column, and the sensitivity of the fluorescence detector is increased 10-fold by the formation of a post-column derivative with ammonia solution. AS

39

Distribution of tritium-labeled T-2 toxin in swine.

Robison, T. S.; Mirocha, C. J.; Kurtz, H. J.; Behrens, J. C.; Weaver, G. A.; Chi, M. S.

Journal of Agricultural and Food Chemistry 27 (6) 1411-1413 (1979) [17 ref. En] [Dep. of Plant Pathology, Univ. of Minnesota, St. Paul, Minnesota 55108, USA]

2 weanling crossbreed pigs were intubated with tritium-labelled 4β,15-diacetoxy-3α-hydroxy-8α-(3-methylbutyryloxy)-12,13-epoxytrichothecene (T-2) toxin to determine the tissue distribution and the excretion pattern of T-2 and/or its metabolites. % of administered radioactivity (18 h after dosing) in one animal intubated with 0.1 mg [³H]T-2/kg body wt. in 50% aqueous ethanol (0.75 ml) was 0.7 (muscle), 0.43 (liver), 0.08 (kidney), 0.06 (bile), 21.6 (urine), and 25.0 (faeces). The calculated residue levels for T-2 and/or its metabolites based on specific radioactivity of the tissue were muscle, 3.1 p.p.b.; fat, 0.49 p.p.b.; liver 13.8 p.p.b.; and kidney 15.9

p.p.b. % of administered radioactivity in the other animal intubated with 0.4 mg [^3H]T-2/kg body wt. (1.22×10^{10} dpm) was 0.7 (muscle), 0.29 (liver), 0.08 (kidney), 0.14 (bile), 17.6% (urine), and 0.84 (faeces). Corresponding residue levels for T-2 toxin in the tissues of this animal were muscle, 11.5 p.p.b.; liver, 37.7 p.p.b.; and kidney, 61.4 p.p.b. Since these residue levels were low, it was impossible to chemically identify the metabolites present. AS

40

Toxicity and mutagenicity of molds of the *Aspergillus glaucus* group. Identification of physcion and three related anthraquinones as main toxic constituents from *Aspergillus chevalieri*.

Bachmann, M.; Lüthy, J.; Schlatter, C.

Journal of Agricultural and Food Chemistry 27 (6) 1342-1347 (1979) [36 ref. En] [Swiss Federal Inst. of Tech. & Univ. of Zurich, Schorenstrasse 16, 8603 Schwerzenbach, Switzerland]

41

[Biological testing using the brine shrimp. II. The synergistic effects of mycotoxins to brine shrimp.]

Tanaka, K.; Manabe, M.; Matsuura, S.

Report of the National Food Research Institute

[*Shokuryo Kenkyusho Kenkyu Hokoku*] No. 34, 84-88 (1979) [6 ref. Ja, en] [Nat. Food Res. Inst., Min. of Agric., Forestry & Fisheries, Tokyo, Japan]

The synergistic effects of mycotoxins to brine shrimp were examined. (i) Aflatoxin B₁, (ii) diacetoxyscirpenol, (iii) fusarenon-X, (iv) ochratoxin A, (v) sterigmatocystin and (vi) T-2 toxin were used as the mycotoxins. The mycotoxins were classified into 3 groups on the basis of the shape of the bioassay curve (48 h mortality vs. concn.). It is hypothesized that if half the median tolerance limit (TL_m) of 2 of the toxins should produce a mortality of > 60%, then this can be taken to be evidence of a synergism between them. By this criterion, a synergistic effect was observed between (iii) and (iv), but toxicities of other pairs were found to be merely additive. [From En summ.] [See FSTA (1976) 8 1A7 for part I.] JRR

42

Mollicellins: mutagenic and antibacterial mycotoxins.

Stark, A. A.; Kobbe, B.; Matsuo, K.; Büchi, G.; Wogan, G. N.; Demain, A. L.

Applied and Environmental Microbiology 36 (3) 412-420 (1978) [11 ref. En] [Dep. of Nutr. & Food Sci., Massachusetts Inst. of Tech., Cambridge, Massachusetts 02139, USA]

Studies on mollicellins (depsidone mycotoxins formed by *Chaetomium mollicellum*) are described. 8 mollicellins were evaluated for mutagenicity and antibacterial activity in *Salmonella*/microsome tests based on detn. of histidine reversion and forward mutation to 8-azaguanine resistance. Tables and graphs of results are given. The results show that 4 of the mollicellins were bactericidal; 2 of these were also mutagenic. Sensitivity of the mutagenicity tests used is critically discussed; differences between results

obtained under different test conditions suggest that any single mutagenesis test is insufficient to estimate mutagenic potential. The relationship between structure and activity of the mollicellins is discussed. Incubation with rat microsomes eliminated mutagenic activity and reduced antibacterial activity of the mollicellins. These results may be of public health significance in relation to the stability of mollicellins and their possible formation by *Chaetomium* sp. growing on foods, e.g. rice, during storage. AJDW

43

[Bibliography of *Fusarium* toxins.] Bibliographie der *Fusarium*-Toxine.

Meyer, H.; Frank, H. K.

Berichte der Bundesforschungsanstalt für Ernährung No. 2, 310pp. (1979) [De, en] [Bundesforschungsanstalt für Ernährung, Karlsruhe, Federal Republic of Germany]

This publication comprises the following sections: a 2978-item bibliography, arranged in alphabetical order of authors (pp. 1-229); classified indexes for entries on individual aspects of *Fusarium* toxins (pp. 231-268), *Fusarium* toxicoses (pp. 268-275), and moulds forming these toxins (pp. 275-308); and a register of toxins (pp. 309-310). AJDW

44

A comparison of two quantitative mass spectrometric methods for the analysis of patulin in apple juice.

Price, K. R.

Biomedical Mass Spectrometry 6 (12) 573-574 (1979) [9 ref. En] [Food Res. Inst., Colney Lane, Norwich NR4 7UA, UK]

High resolution single ion monitoring and low resolution multiple ion monitoring without the use of an internal standard were compared as methods for the MS measurement of patulin in apple juice extracts. Single ion monitoring was the more sensitive method and reliably measured 0.2 parts/billion (p.p.b.) patulin in apple juice, while multiple ion monitoring gave a detection limit of 5 p.p.b. and could reliably measure 10 p.p.b. A perdeuterated analogue of silylated patulin was unsuitable either as internal standard or as carrier. AS

45

[Preliminary studies on toxin production by decay organisms in potatoes.] Vorläufige Untersuchungen über die Produktion von Toxinen durch Fäuleerreger bei Kartoffeln.

Siegfried, R.; Langerfeld, E.

Potato Research 21 (4) 335-339 (1978) [10 ref. De] [Staatliche Landwirtschaftliche Untersuchungs- & Forschungsanstalt Augustenberg, Nesslerstrasse 23, D-7500 Karlsruhe 41, Federal Republic of Germany]

The *Artemia salina* test [see FSTA (1974) 6 10C347] was used to determine the toxicity of decay organisms isolated from potato tubers. Toxin production was detected in several *Fusarium* species. No diffusion of toxins from decayed to healthy tissue was observed. No significant differences in toxin production were observed between incubation at 6°, 15° and 20°C,

between potato var., and in mixed infection with *Fusarium* spp. and *Erwinia carotovora* var. *atroseptica*. RM

46

[Naturally occurring mycotoxin contamination of apples and other products. Application of new analytical technique.]

Burdaspal, P. A.; Pinilla, I.

Alimentaria No. 107, 35-37 (1979) [10 ref. Es] [Cent. Nacional de Alimentacion & Nutr., Majadahonda, Madrid, Spain]

The TLC method of Gimeno [see FSTA (1979) 11 11C655] was used to determine the presence of mycotoxins in 104 naturally contaminated apples. Patulin was detected in 55 (52.9%), all of which contained *Penicillium expansum*; the patulin concn. ranged from 1 to 250 mg/kg. Additionally, 24 samples of pears, 12 of apricots and 15 of peaches were examined; patulin was detected in 8 (0.9-1.0 mg/kg), 6 (2-13 mg/kg) and 6 (trace-20 mg/kg), resp. HBr

47

Protocols for surveys, sampling, post-collection handling, and analysis of grain samples involved in mycotoxin problems.

Davis, N. D.; Dickens, J. W.; Freie, R. L.; Hamilton, P. B.; Shotwell, O. L.; Wyllie, T. D.

Journal of the Association of Official Analytical Chemists 63 (1) 95-102 (1980) [25 ref. En] [Auburn Univ., Auburn, Alabama 36830, USA]

This report examines and summarizes current knowledge regarding mycotoxin surveys, sampling techniques, conditions conducive to post-collection production of mycotoxins in grain samples, and analytical methods for mycotoxin analysis. Priority attention is given to samples of corn suspected of containing aflatoxin. The report includes recommendations where deemed appropriate by the Ad Hoc Work Group [to State Agricultural Experiment Stations - USDA Mycotoxin Research Coordinating Committee]. AS

48

Fate of ochratoxin A in goats.

Nip, W. K.; Chu, F. S.

Journal of Environmental Science and Health, B B14 (3) 319-333 (1979) [30 ref. En] [Food Res. Inst., Univ. of Wisconsin-Madison, Madison, Wisconsin 53706, USA]

A single oral dose of 0.5 mg [³H]ochratoxin A/kg was given to 2 lactating La Mancha goats. Milk, urine, faeces and serum samples collected during the next 7 days contained, resp., 6, 38, 53 and 2.3% of total radioactivity ingested. Only a small amount of free ochratoxin A (<0.03% of total dose) was excreted in milk during the 7 day collection period. 2 metabolites of ochratoxin A were present in milk. Attempts to identify these are described. MEG

49

Comparative study of two screening media for detecting mycotoxins.

Mabrouk, S. S.; El-Shayeb, N. M. A.

Chemie Mikrobiologie Technologie der Lebensmittel 6 (4) 106-112 (1980) [21 ref. En, de] [Lab. of Natural Products, Nat. Res. Cent., Dokki, Cairo, Egypt]

Screening of 22 Egyptian and 4 other toxicogenic *Aspergillus* and *Penicillium* isolates was carried out to investigate their potentiality to produce mycotoxins using rice corn steep agar (RCA) medium as compared to yeast extract sucrose (YES) medium, in relation to different periods of incubation. In the liquid medium, both shake and static cultures were used. The mycelia and culture filtrates were also submitted for mycotoxin screening. The RCA medium enhanced both aflatoxin and sterigmatocystin formation. YES medium was more suitable for ochratoxin and patulin formation. Citrinin production was similar on the 2 culture media investigated. AS

50

[Microbiological evaluation of brewer's barley from the 1978 harvest.]

Chelkowski, J.; Bogacz, I.; Kaczmarek, T.

Przemysl Fermentacyjny i Owocowo-Warzywny 23 (8) 6 (1979) [3 ref. Pl]

Deterioration of barley quality has been observed over the last 2 yr, resulting in grain with spore counts of 10⁷/g entering the processing channels. In about 30% of products infested by moulds, ochratoxin A was found, but the level was only 130 parts/billion. In 33 cases moulds from 5 isolates exhibited an ability to produce sterigmatocystin, which is similar to aflatoxin. The number of spores of moulds in barley var. was lower than in similar samples from the 1977 harvest, and did not exceed 4000 spores/g. It is concluded that due to the increase in harvesting rate by combine harvesters, the stored barley is prone to mould attack and reduction of germinating power. Special care must be taken to process wet grain to eliminate mould attack and mycotoxin formation. Spore count is not a definite criterion to assess the contamination of grain with mycotoxins. STI

51

[Detection of *Fusarium* toxins in potatoes by means of the chicken-embryo-assay.]

Nachweis von Fusarientoxinen in Kartoffeln über den Hühnerembryonen-Test.

Polzhofer, K.; Niehuss, M.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 170 (2) 124-128 (1980) [16 ref. De, en]

[NATEC, Inst. für Naturwissenschaftlich-Tech. Dienste GmbH, Behringstrasse 154, D-2000 Hamburg 50, Federal Republic of Germany]

The following spp. of *Fusarium* were cultivated on potatoes: *F. avenaceum*, *F. coeruleum*, *F. sulphureum* and *F. solani*. Only *F. avenaceum* grew well under the conditions used: Cylindrical sticks were cut out from potatoes at rotted locations. These sticks were cut into discs of approx. 1 mm thickness which were extracted with ethyl acetate. The extract was purified by liquid-liquid-partition and used for toxin estimation by the chicken-embryo-assay. A significant mortality rate of 80-93% was found with the rotten potatoes. Similar mortality rates were observed with potato tissue adjacent to the rotten parts of the potatoes even though

this tissue did not show any optical damage. Assuming that *Fusarium*-toxins caused the toxic effect the detection limit of the bio-assay-method lies at 0.5 p.p.m. toxin (expressed as diacetoxyscirpenol-units). AS

52

[Is saltpetre dispensable in cheesemaking?] [Review] Nielsen, E. W.

Mælkeritidende 93 (4) 97-102 (1980) [17 ref. Da] [Dan Kongelige Veterinaer- og Landbohøjskole, Copenhagen, Denmark]

Nitrate, often in the form of KNO_3 , is added to cheese milk to prevent fermentation of butyric acid bacteria, which are inhibited by the nitrite formed from the nitrate. This review considers possible ways of reducing or eliminating the use of nitrate for this purpose, including: decreasing the number of butyric acid bacteria spores in the cheese milk, e.g. by bacteriostatic use of bacteria which produce nisin or other substances inhibiting butyric acid bacteria; addition of lysozyme to cheese milk; and early salting of the cheese. Danish experiments with lysozyme and with early salting (involving addition of ≤ 2250 g salt/100 l cheese milk at an early stage in Samso cheese manufacture, while the curd was still being stirred) are reported in detail. It is claimed that useful results have been obtained from these experiments, which, together with other research, should provide a basis for the development of satisfactory alternatives to the use of nitrate in cheesemaking. ADL

53

[Quantitative determination of sterigmatocystin in mouldy foods of plant origin.] Quantitative Bestimmung von Sterigmatocystin in verschimmelten pflanzlichen Nahrungsmitteln.

Schmidt, R.; Neunhoeffer, K.; Dose, K.

Zeitschrift für Analytische Chemie 299 (5) 382-384 (1979) [10 ref. De, en] [Johannes-Gutenberg-Univ., D-6500 Mainz, Federal Republic of Germany]

Quantitative detn. of sterigmatocystin in extracts of foods of plant origin is achieved by 2-dimensional TLC of extracts, and measurements of the fluorescence of the spots on AlCl_3 -treated plates (illumination by Hg lamp at 360 nm). Samples and standards are applied to the TLC plates in a way that permits quick identification and assay. Acetonitrile-KCl was the best extracting solvent (180 ml acetonitrile + 20 ml 4% KCl). Losses of $< 5\%$ were obtained in recovery tests with toxin added to lentils. Substitution of 2-dimensional TLC for column chromatography improved toxin detection, eliminated losses of sterigmatocystin, and saved time. RM

54

Mold toxins: hazard to animal and human health. Kobbe, B.

California Agriculture 33 (11/12) 18-19 (1979) [En]

55

Mutagenicity of 5,6-dimethoxysterigmatocystin, a metabolite from *Aspergillus multicolor*, in the *Salmonella*/microsome system.

Wehner, F. C.; Thiel, P. G.; Vleggaar, R.

Applied and Environmental Microbiology 38 (5) 1015-1017 (1979) [17 ref. En] [Nat. Res. Inst. for Nutr. Diseases, S. African Med. Res. Council, Tygerberg 7505, South Africa]

The natural sterigmatocystin derivative, 5,6-dimethoxysterigmatocystin, isolated from a corn meal culture of *A. multicolor*, was found to be a mutagen for *Salmonella typhimurium* strains TA98 and TA100 after metabolic activation in a mammalian microsome system. *A. multicolor* has not been implicated in the outbreak of any mycotoxicoses nor is it frequently reported as a contaminating fungus on foodstuffs, however, the production of a mutagenic substance by this fungus indicates the potential carcinogenic hazard of commodities contaminated by it. AL

56

[Presence of aflatoxins, sterigmatocystin and ochratoxin in green coffee beans.] (In '8th International Scientific Colloquium on Coffee' [see FSTA (1980) 12 8H1257]) [Lecture]

Palo, D. de; Gabucci, G.; Valussi, S. pp. 539-543 (1979) [42 ref. Fr, en]

In the port of Trieste, during 1 yr, no mycotoxins could be detected in 502 samples of green coffee taken from cargos originating from different parts of the world (55% from Indonesia, 30% from Africa, 10% from Brazil, and 5% from other ports of South America) by using a new method for the detection of aflatoxins and sterigmatocystin. However, in samples taken from 6 stocks of unmarketable coffee of Central African origin, which had been stored in the warehouse for 2 yr, 12 mg sterigmatocystin/kg was detected in 1 sample. ESK

57

Cyclopiazonic acid production by *Penicillium camemberti* Thom and natural occurrence of this mycotoxin in cheese.

Bars, J. le

Applied and Environmental Microbiology 38 (6) 1052-1055 (1979) [14 ref. En] [Sta. de Pharmacol.-Toxicol., INRA, 31300 Toulouse, France]

Every *Penicillium camemberti* strain freshly isolated from 20 commercial cheese brands produced cyclopiazonic acid in 2 culture media at 25°, 13°, and 4°C; toxin yield was greatly dependent on the strain and environmental parameters (medium, temp., and incubation time). The toxigenic ability appeared as a log-normal distribution. This mycotoxin was found in the crust (0.05-0.1 µg/g in 3 samples, 0.1-0.2 µg/g in 5 samples, and 0.4, 1, and 1.5 µg/g in 3 other samples) but not in the inner part. When its acute toxicity is considered, doses eventually ingested by consumers are very low (< 4 µg). Means for prevention are discussed. A highly toxigenic strength and rate appear to be necessary features leading to natural contamination in cheeses. The distribution of toxigenic ability makes possible without delay a choice of weakly toxic strains. AS

58

Thin layer chromatographic method for analysis and chemical confirmation of sterigmatocystin in cheese. Egmond, H. P. van; Paulsch, W. E.; Deijl, E.; Schuller,

P. L.

Journal of the Association of Official Analytical Chemists 63 (1) 110-114 (1980) [13 ref. En] [Lab. for Chem. Analysis of Foodstuffs, Nat. Inst. of Public Health, PO Box 1, 3720 BA Bilthoven, Netherlands]

A semi-quantitative method is described for analysis of sterigmatocystin in cheese. The method is based on extraction of cheese with methanol/4% KCl (9+1), followed by Florisil and polyamide column cleanup and 2-dimensional TLC. Visualization of sterigmatocystin on the TLC plates is enhanced by an AlCl_3 spray reagent. Identity of sterigmatocystin is confirmed by a 2-dimensional TLC test based on reaction with trifluoroacetic acid on the plate after 1st development. The reaction product formed is visualized by spraying with AlCl_3 . The method allows detection and confirmation of sterigmatocystin in cheese at concn. as low as 5 $\mu\text{g/kg}$. The method was applied to cheese samples ripening in warehouses and naturally moulded with *Aspergillus versicolor*. AS

59

Fungal growth and the presence of sterigmatocystin in hard cheese.

Northolt, M. D.; Egmond, H. P. van; Soentoro, P.; Deijl, E.

Journal of the Association of Official Analytical Chemists 63 (1) 115-119 (1980) [20 ref. En] [Lab. for Zoonoses & Food Microbiol., Nat. Inst. of Public Health, PO Box 1, 3720 BA Bilthoven, Netherlands]

Moulds isolated from visibly moulded cheeses in shops, households, and warehouses were identified. Mould flora of cheeses in shops and households consisted mainly of *Penicillium verrucosum* var. *cyclopium*. On cheeses ripening in warehouses, *P. verrucosum* var. *cyclopium*, *Aspergillus versicolor*, *A. repens*, and *P. verrucosum* var. *verrucosum* were the dominant mould spp. Cheeses ripening in warehouses and moulded with *A. versicolor* were examined for sterigmatocystin. 9 of 39 cheese samples contained sterigmatocystin in the surface layer in concn. ranging from 5 to 600 $\mu\text{g/kg}$. AS

60

Acute toxicity of patulin and its interaction with penicillic acid in dogs.

Reddy, C. S.; Chan, P. K.; Hayes, A. W.; Williams, W. L. *Food and Cosmetics Toxicology* 17 (6) 605-609 (1979) [24 ref. En] [Dep. of Pharmacology & Toxicol., Univ. of Mississippi Med. Cent., Jackson, Mississippi 39216, USA]

61

Improved method for thin layer chromatographic analysis of mycotoxins.

Gimeno, A.

Journal of the Association of Official Analytical Chemists 63 (2) 182-186 (1980) [9 ref. En] [Piensos Compuestos Rosell SA (Picrosa), Lab. Control de Calidad, Francisco Moragas, 12, Manresa, Barcelona, Spain]

The author's previously published multimycotoxin method [see FSTA (1979) 11 11C655] is improved by a

series of changes in the development of the citrinin. Importance of the type of UV lamp and the use of a yellow filter are also emphasized. AS

62

Metabolism of [^{14}C]zearalenone in laying hens.

Dailey, R. E.

Journal of Agricultural and Food Chemistry 28 (2) 286-291 (1980) [8 ref. En] [Div. of Toxicology, FDA, Beltsville, Maryland 20705, USA]

A single dose of 10 mg [^{14}C]zearalenone/kg was administered by gavage to White Leghorn laying hens, and its absorption, distribution, and excretion at 2, 4, 24, 48, and 72 h after dosage were studied. ^{14}C -Labelled residues in excreta, bile, egg yolk, clutch, and liver were partially characterized. No major retention sites of ^{14}C activity were found in edible muscle tissues but persistent levels of lipophilic metabolite(s) were detected in egg yolk at a concn. of 195 $\mu\text{g-equiv./100 g}$ wet wt. (about 2 p.p.m.) 72 h after dosing. AS

63

[Method for quantitative determination of ochratoxin A in foods and feeds by means of high-pressure liquid chromatography (HPLC).] Methode zur Ochratoxin-A-Bestimmung in Lebens- und Futtermitteln mittels Hochdruckflüssigkeitschromatographie (HPLC). Schweighardt, H.; Schuh, M.; Abdel-Hamid, A. M.; Böhm, J.; Leibetseder, J.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 170 (5) 355-359 (1980) [27 ref. De, en] [Inst. für Ernährung, Vet.-Med. Univ., Vienna, Austria]

A rapid, specific HPLC-method has been developed for quantitative determination of ochratoxin A in food and feedstuffs as well as in mixed feed. After preliminary clean-up of the methanol/chloroform extract the ochratoxin is analysed using HPLC with a Spherisorb S5 ODS column methanol/water/acetic acid as eluent and a fluorescence detector. The average recovery was about 50% in the range 50-500 parts/billion (p.p.b.) with a small variation (coeff. of variation 10.24% and 23.65%). The detection limit for ochratoxin A is 5 p.p.b. AS

64

[Mycotoxins in food. A review.]

Josefsson, E.

Var Föda 31 (6) 351-356 (1979) [24 ref. Sv] [Livsmedelslab., Statens Livsmedelsverk, S-751 26 Uppsala, Sweden]

Problems with aflatoxins in foods are discussed with reference to: mycotoxins of significance, the organisms which form them, the foods in which they occur, and their toxic and/or carcinogenic effects; aflatoxins in nuts; mycotoxins in milk; ochratoxin in porcine kidneys; mycotoxins in cereals and bread; mycotoxins in peas and beans; patulin in fruit, berries and juices; and general aspects. AJDW

65

[Patulin in fruit, berries and juices. Methods for elimination of patulin.]

Andersson, A.; Josefsson, E.

Var Föda 31 (6) 365-374 (1979) [23 ref. Sv, en]

[Livsmedelslab., Statens Livsmedelsverk, S-751 26 Uppsala, Sweden]

A procedure for detn. of patulin in fruit, berries and fruit juices is described, based on extraction of patulin with ethyl acetate, clean-up of the extract on a silica gel column (elution with ethyl acetate/toluene (60:140), derivatization with *N*, *O*-bis(trimethylsilyl)acetamide, and GLC analysis on a packed column (4% SF-96 + 8% QF1) or a capillary column (SE-30 or Silar 10 C), using β -HCH as internal standard. Tests on 48 samples of fruit, etc. (blackberries, bilberries, canned clementines, raspberries, lingonberries, rose hip powder, rose hip tea, plum juice, tomatoes, mashed potato powder) showed no patulin-positive samples. Of 49 apple juice samples studied, 40 were patulin-positive, patulin concn. up to 70 μ g/l being recorded. Studies were conducted on processing of apple juice to eliminate patulin. Fermentation with wine yeast reduced patulin concn. to a level below the detection limit within 18 days. Treatment of apple juice with SO₂ (800 mg/l) for 18 h reduced patulin concn. by approx. 65%; treatment with 200 mg SO₂/l had little effect on patulin concn. Boiling had very little effect on patulin concn. in apple juice, bilberry jam or apple sauce. Active C reduced patulin concn. in apple juice; approx. 3 g active C/l was required to reduce patulin concn. to 10% of the initial value. AJDW

66

[Formation and distribution of patulin in jam, apple sauce and apples.]

Akerstrand, K.; Andersson, A.

Var Föda 31 (6) 357-363 (1979) [8 ref. Sv, en] [Biol. Lab., Statens Livsmedelsverk, S-751 26 Uppsala, Sweden]

Studies were conducted on growth and patulin production of *Penicillium expansum* in inoculated samples of apple sauce (with 0-33 g sugar/100 g, and with or without 0.5 g sodium benzoate/kg), and various bilberry, raspberry and lingonberry jams with various sugar contents, made with or without sorbate or benzoate, and stored for $\leq$ 225 days. Data are presented for intensity of mould growth and patulin concn. in the apple sauces, including data showing patulin concn. at various levels in the jar. Addition of preservative reduced mould growth, but had little effect on patulin concn. in the apple sauce made without added sugar. No patulin was formed in apple sauce or jams made with normal sugar concn. Patulin formation and concn. was not clearly related to the extent of growth of the mould. Presence of patulin in jam and apple sauce was not restricted to the surface layers. Studies were also conducted on apples inoculated with *P. expansum* and stored for 3-12 days at room temp. High concn. of patulin (up to 22 100 μ g/kg) were detected in the brown, rotten areas; patulin concn. in healthy tissue of apples with rotten patches were low. Practical implications of these results are briefly considered. AJDW

67

Measurement of patulin in grapes and wines.

Ough, C. S.; Corison, C. A.

Journal of Food Science 45 (3) 476-478 (1980) [En] [Dep. of Viticulture & Enology, Univ. of California, Davis, California 95616, USA]

A fluorometric scanning technique was developed to measure patulin samples separated by 2-dimensional TLC. The chromatographed samples were extracted and purified prior to separation. The coeff. of variation of all measurements reported was 11.4%. Patulin was very stable in grape juice or grape wine with no significant change for 1 month at room temp. or 2 months in the frozen state. It disappeared rapidly during fermentation to essentially zero. Addition of SO₂ at normal levels (100 mg/l) to a sample containing 25 mg/l of patulin caused the patulin to decrease to about one-half in 15 min. Tests with badly infected grapes, *Botrytis cinerea*, *Aspergillus niger*, and *Penicillium expansum*, failed to show any significant amount of patulin produced under the test conditions. IFT

68

Patulin production by *Byssoschlamys* spp. in canned grape juice.

Rice, S. L.

Journal of Food Science 45 (3) 485-488, 495 (1980) [En] [Food Sci. Inst., Purdue Univ., W. Lafayette, Indiana 47907, USA]

While it has previously been suspected that *Byssoschlamys* spp. may grow in canned fruits and produce the mycotoxin patulin, direct evidence for this occurrence is not available. Effects of different initial static O₂ levels and temp. on formation of patulin by *B. nivea* in Concord grape juice packed in glass jars was examined. The greatest amount of patulin (0.31 mg/50 ml) was formed after 28 days in jars with a 5.1 cm headspace incubated at 20°C. Patulin was formed more rapidly at 25° and 30°C, but declined in amounts after reaching max. values. Cultures of *B. fulva* and *B. nivea* produced less patulin in grape juice packed in glass jars with headspaces of 2.5 and 1.3 cm than in glass jars with a 5.1 cm headspace. More favourable conditions were used in this study to produce patulin than would be found in commercial production of Concord grape juice. IFT

69

Survey for aflatoxins and zearalenone in canned and frozen sweet corn.

Stoloff, L.; Francis, O. J., Jr.

Journal of the Association of Official Analytical Chemists 63 (2) 180-181 (1980) [9 ref. En] [Div. of Food Tech., FDA, Washington, DC 20204, USA]

Aflatoxins and zearalenone were determined in 263 samples of canned or frozen sweet corn, collected from packing plants during the 1976 and 1977 packing seasons. As anticipated from geographic, agronomic, and microbiological considerations, no aflatoxin or zearalenone was found. Based on this sampling, the highest incidence of detectable aflatoxin that could be statistically anticipated in the major packing areas is 1.5%. AS

70

[Moulds and mycotoxins in beans and peas.]

Akerstrand, K.; Josefsson, E.

Var Föda 31 (6) 405-414 (1979) [22 ref. Sv, en] [Biol. Lab., Statens Livsmedelsverk, S-751 26 Uppsala, Sweden]

Studies were conducted on moulds and mycotoxins in and on (i) brown beans, (ii) white beans, (iii) yellow peas and (iv) green peas. Values for the % of samples contaminated with moulds, before and after surface disinfection resp., were: (i) 100 and 84; (ii) 96 and 19; (iii) 74 and 12; and (iv) 92 and 36. Ranges and median values for mould counts after surface disinfection were (count/g): (i) 10–125 000 and 50; (ii) 10–3600 and 20; (iii) 10–40 and 5; and (iv) 10–3000 and 10. Data are given for the frequency of occurrence of various mould spp. Toxigenic mould spp. isolated include *Penicillium verrucosum* var. *cyclopium*, *P. verrucosum* var. *verrucosum*, *P. expansum*, *P. griseofulvum* and *P. citrinum*. Ochratoxin A was detected in 4 of 31 (i) samples in 1976, 2 of 27 (iii) samples in 1976, and 2 of 22 (i) samples in 1977, at a max. concn. of 442 µg/kg. Zearalenone was detected in 1 (iii) sample in 1976 (2 µg/kg), and penicillic acid was detected in 1 (iv) sample in 1976 (24 µg/kg). AJDW

71

3'-Hydroxyzearalenones, two new metabolites produced by *Fusarium roseum*.

Pathre, S. V.; Fenton, S. W.; Mirocha, C. J. *Journal of Agricultural and Food Chemistry* 28 (2) 421–424 (1980) [9 ref. En] [Dep. of Plant Path., Univ. of Minnesota, St Paul, Minnesota 55108, USA]

Two new metabolites related to zearalenone [6-(10-hydroxy-6-oxo-*trans*-1-undecenyl)-β-resorcylic acid lactone] were isolated from rice cultures of *Fusarium roseum* and were shown to be diastereomeric 3'-hydroxyzearalenones [6-(3,10-dihydroxy-6-oxo-*trans*-1-undecenyl)-β-resorcylic acid lactone]. Accumulation of 3'-hydroxyzearalenones as the culture ages suggests that these hydroxy derivatives are the product of zearalenone metabolism by *F. roseum*. AS

72

[Mycotoxins in bread grains.]

Josefsson, E.

Var Föda 31 (6) 379–384 (1979) [16 ref. Sv, en] [Livsmedelslab., Statens Livsmedelsverk, S-751 26 Uppsala, Sweden]

Studies on occurrence of mycotoxins in bread cereals (wheat and rye) and flours in Sweden are described. 53 samples of grain were analysed immediately after harvest; 38 samples were examined after storage on the farm. 22 samples each of wheat and rye flour were obtained directly from the mills; 9 samples of wheat flour and 11 of rye flour were purchased in retail shops. 1 sample of rye grain stored on the farm contained 165 µg ochratoxin A/kg. No mycotoxins were detected in any of the other grain or flour samples studied. AJDW

73

[Ochratoxin A in pig kidneys.]

Josefsson, E.

Var Föda 31 (6) 415–420 (1979) [10 ref. Sv, en] [Livsmedelslab., Statens Livsmedelsverk, S-751 26 Uppsala, Sweden]

A total of 90 nephropathic kidneys from pigs slaughtered in Sweden in 1978 were analysed for

ochratoxin A by HPLC. 24 of the kidneys contained ochratoxin A; the max. ochratoxin A concn. recorded was 88 µg/kg. The 15 kidneys with the highest ochratoxin concn. from one of the slaughterhouses studied came from pigs from a single farm; these pigs had been fed on stored grain from the previous years' harvest. This grain was found to contain 3100 µg ochratoxin/kg; *Penicillium viridicatum* predominated in the mycoflora. AJDW

74

Confirmation of ochratoxin A by chemical derivatisation and high-performance liquid chromatography.

Hunt, D. C.; McConnie, B. R.; Crosby, N. T.

Analyst 105 (1246) 89–90 (1980) [4 ref. En] [Lab. of Gov. Chem., Cornwall House, Stamford Street, London SE1 9NQ, UK]

A previous paper (see FSTA (1980) 12 5S801) described the detn. of ochratoxin A (OA) in pig kidney using HPLC. This method employed a post-column reaction to produce a pH shift; the presence of the OA peak at high pH and its subsequent diminution at low pH were used for OA quantitation and confirmation, resp. The authors subsequently examined other means of confirming the identity of OA, in particular preparation of the methyl ester. This paper reports a rapid and simple method for the formation of the methyl ester. It involves the following stages: 50 µl of the final acetonitrile extract obtained by the above HPLC method is transferred to a small glass vial and evaporated to dryness using a stream of N₂; 50 µl of a BF₃-methanol complex are added and the vial is placed on a hot-plate at 65°C for 15 min; any remaining reagent is removed using N₂ and the residue is dissolved in 50 µl acetonitrile; 20 µl of the solution is injected into the HPLC column. Conversion of OA into the methyl ester is virtually complete. The detection limit for the methyl ester is 0.5 µg/kg. A chromatogram is included of an extract of pig kidney (containing 5 µg OA/kg) before and after derivatization. JA

75

***Penicillium crustosum* and *P. simplicissimum*, the correct names for two common species producing tremorgenic mycotoxins.**

Pitt, J. I.

Mycologia 71 (6) 1166–1177 (1979) [21 ref. En] [CSIRO Div. of Food Res., N. Ryde, NSW 2113, Australia]

Literature reports have used the names *P. cyclopium*, *P. verrucosum* var. *cyclopium*, *P. palitans* and *P. crustosum* for isolates (e.g. from mouldy corn) producing the tremorgenic mycotoxin penitrem A. Producers of verruculogen, another tremorgenic mycotoxin, have been reported as *P. verruculosum* (from peanuts), *P. parakerquei*, *P. piscarium* and *P. estinogenum*. From comparative taxonomic studies, it is concluded that all the isolates belong to only 2 spp., i.e. *P. crustosum*, producing penitrem A, and *P. simplicissimum* producing verruculogen. [From En summ]. RM

76

Enzymatic formation of the bisfuran structure in aflatoxin biosynthesis.

Wan, N. C.; Hsieh, D. P. H.

Applied and Environmental Microbiology 39 (1) 109-112 (1980) [17 ref. En] [Dep. of Environmental Toxicology, Univ. of California, Davis, California 95616, USA]

A relatively stable enzyme system that converts versiconal hemiacetal acetate (VHA) to versicolorin A (VLA) was isolated from the soluble fraction of the homogenized cells of *Aspergillus parasiticus* ATCC 15517. The intracellular distribution of activity, kinetics of conversion, and some biochemical properties of the enzyme system are described. It is suggested that inhibition of this enzyme system by suitable agents may offer a way to control the foodborne hazards related to bisfuranoid mycotoxins. AL

77

Production and biological activity of secalononic acid D.

Ciegler, A.; Hayes, A. W.; Vesonder, R. F.

Applied and Environmental Microbiology 39 (2) 285-287 (1980) [12 ref. En] [S. Reg. Res. Cent., Sci. & Education Administration, USDA, New Orleans, Louisiana 70179, USA]

20 isolates of *Penicillium oxalicum* (a common fungus in cereals and maize) produced secalononic acid as their major secondary metabolite. Fermentation conditions were determined for toxin production in grain and liquid media. The 50% lethal dose value for mice ranged from 26.5 to 51.7 mg/kg dependent on animal strain and sex, males being more susceptible than females. Secalononic acid was nontoxic and nonteratogenic to the chicken embryo and exhibited poor antibiotic properties. Its potential role in mycotoxicoses is discussed. AS

78

Interactions of mycotoxins in animal production.

Proceedings of a Symposium July 13, 1978, Michigan State University. [Conference proceedings]

United States of America, American Society of Animal Science; United States of America, American Dairy Science Association; United States of America, Committee on Animal Nutrition, National Research Council

viii + 197pp. ISBN 0-309-02876-0 (1979) [many ref. En] Washington, DC, USA; National Academy of Sciences.

This symposium developed from the work of a task force set up by the USA National Research Council to investigate the influence of mycotoxins on nutrient utilization. The symposium was divided into 4 parts: Review of known mycotoxins (pp. 3-39); Biological actions of mycotoxins on farm animals (pp. 43-136); Analytical methods for mycotoxins (pp. 139-153); and Contamination of feeds and residues of mycotoxins in animal tissues (pp. 157-195). Papers given include: Introduction, definition, and history of mycotoxins of importance to animal production, by C. W. Hesseltine (pp. 3-18, many ref.). Field and storage conditions for the production of mycotoxins and geographic

distribution of some mycotoxin problems in the United States, by J. Tuite (pp. 19-39, 160 ref.). Biological effects of mycotoxins (other than aflatoxin) on poultry, by R. D. Wyatt (pp. 87-95, 34 ref.). Effects of mycotoxins on ruminants, by G. P. Lynch (pp. 96-117, many ref.). Biological effects of mycotoxins upon rumen-function and lactating dairy cows, by D. R. Mertens (pp. 118-136, 93 ref.). Utilization of aflatoxin contaminated feed, by A. C. Keyl & W. P. Norred (pp. 185-195, 4 ref.). A further 2 papers are abstracted separately in FSTA and are listed in the author index under United States of America, American Society of Animal Science [Mycotoxins Symposium]. SP

79

Mycotoxin residues in body fluids and tissues of food-producing animals. (In 'Abstracts of the XII International Congress of Microbiology' [see FSTA (1980) 12 10B73].) [Lecture]

Patterson, D. S. P.

p. 59 (undated) [En] [Cent. Vet. Lab., Weybridge, Surrey, UK]

The public health hazard of mycotoxin residues in milk, eggs and tissues of food-producing animals is discussed. Assessments of relative hazards to man of direct and indirect exposure to mycotoxins, and effectiveness of current regulatory control measures are considered. MEG

80

[Studies on effects of bisulphite ions on the mycotoxin patulin. II. Studies with apple juice.]

Untersuchungen über den Einfluss von Hydrogensulfitionen auf das Schimmelpilzgift Patulin. II. Versuche mit Apfelsäften.

Adam, R.

Deutsche Lebensmittel-Rundschau 76 (4) 123-125 (1980) [17 ref. De, en, fr] [Inst. für Lebensmittelchem., Bundesforschungsanstalt für Ernährung, Karlsruhe, Federal Republic of Germany]

Studies were conducted on changes in patulin concn. (initially 100 parts/billion) in apple juice during storage under N₂ in the dark at room temp. for up to approx. 300 days. Some samples contained 100 or 200 p.p.m. added SO₂; others were without added SO₂. Some samples with 100 p.p.m. added SO₂ were heated to 75°C for 15 min immediately after heating. Graphs of results are given. Patulin concn. decreased slowly in the samples without added SO₂, i.e. to approx. 55% of the initial value at the end of the storage trial. Patulin concn. decreased to approx. 50% of the initial value in approx. 10 days for the samples with 200 p.p.m. SO₂ or the heated samples containing 100 p.p.m. SO₂, and in approx. 40 days for the unheated sample containing 100 p.p.m. SO₂. Practical implications of the results are briefly discussed. [See FSTA (1980) 12 2A97 for part I.] AJDW

81

Recent outbreaks of mycotoxicoses in man in India.

(In 'Abstracts of the XII International Congress of Microbiology' [see FSTA (1980) 12 10B73].) [Lecture]

Bhat, R. V.; Krishnamachari, K. A. V. R.; Nagarajan, V.; Roy, D. N.; Tulpule, P. G.

p. 168 (undated) [En] [Nat. Inst. of Nutr., Indian Council

of Med. Res., Hyderabad-500 007, India]

2 recent outbreaks of mycotoxicoses in humans caused by consumption of contaminated cereals were studied. An outbreak of aflatoxicosis with a high mortality rate was associated with consumption of maize containing up to 15.6 p.p.m. aflatoxin. Another outbreak of disease was associated with consumption of leavened bread made from ergoty pearl millet. The alkaloids in ergoty millet were different from those in ergoty rye or wheat, and the morphological nature of the fungus, and the clinical symptoms were also different. This outbreak was termed enteroergotism, as distinct from vascular ergotism caused by ergoty rye. DIH

82

Production of cyclopiazonic acid by *Penicillium camemberti* isolates. (In 'Abstracts of the XII International Congress of Microbiology'[see FSTA (1980) 12 10B73].) [Lecture]
Still, P. E.; Eckardt, C.; Leistner, L.
p. 169 (undated) [En] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

Malt extract agar cultures of *P. camemberti* and Camembert cheeses were examined for the mycotoxin cyclopiazonic acid (CA) by TLC on Silicagel 60 using chloroform:isobutylketone (4:1) as developing solvent. CA with an R_f of 0.75 became visible as a purple spot after heating at 110°C for 1–2 min. All 46 strains of *P. camemberti* examined produced CA in malt extract agar, reaching a max. of 1500 µg/20 ml agar in 21 days at 25°C. No CA was detected in Camembert cheese during ripening for 9 days at 14–18°C and storage at 8°C. However, after storage for 5 days at 25°C, the cheese contained 4 p.p.m. CA. Similarly, no CA was detected in 10 different brands of Camembert cheese obtained from refrigerated display cabinets, but 2 cheeses from display cabinets at room temp. contained detectable amounts of CA. Refrigerated storage of ripened Camembert cheeses is recommended. MEG

83

The species composition of fungi from meat products. (In 'Abstracts of the XII International Congress of Microbiology'[see FSTA (1980) 12 10B73].) [Lecture]

Osipian, L. L.; Davtian, S. A.
p. 171 (undated) [En] [Inst. of Microbiol., Academy of Sci. of Armenian SSR, 378510 Abovian City, USSR]

Samples of meat and meat products with signs of spoilage were investigated. Microbiological analysis of investigated samples revealed the presence of 36 spp. of fungi; among them 3 sp. of genus *Mucor* were identified. The remaining isolated cultures were identified as representatives of *Hyphomycetales* (*Penicillium*, *Aspergillus*, *Cladosporium*, *Stemphylium*, *Alternaria*, *Fusarium*). The most diversity was revealed in the genus *Penicillium*, represented by 18 spp. *Penicillium camemberti*, *P. martensii*, *P. roqueforti*, *P. stoloniferum*, *P. lanosum* may be evaluated as more distributed spp. in tested samples. *Aspergilli* were represented by 6 spp., among which *Aspergillus niger* is predominant. The

data do not indicate the presence of specific fungi related to distribution on the meat products. 17 spp. from all isolated cultures are known as toxin producing. Toxicological tests have shown different degrees of toxicity of 11 strains from 18 tested cultures (13 spp.). AS

84

Mycotoxin residues in edible animal tissues. (In 'Interaction of mycotoxins in animal production'[see FSTA (1980) 12 10C416].) [Lecture]
Stoloff, L.

pp. 157–166 (1979) [41 ref. En] [Bureau of Foods, FDA, Washington, DC. 20204, USA]

From metabolism studies with radioactively tagged aflatoxin B₁, ochratoxin A, patulin, penicillic acid, sterigmatocystin, T-2 toxin, and zearalenone, it is apparent that the mature animal is an effective toxin modifier and eliminator. Metabolites of the mycotoxins, with toxicities that vary widely in relation to the parent compounds, are the most likely tissue residues. No evidence could be found for accumulation of any of the toxins or their metabolites. The greatest demonstrated potentials for encountering a mycotoxin residue in edible animal tissue are aflatoxin M in cow's milk and ochratoxin A in swine kidney. AS

85

Simultaneous multi-mycotoxin determination by high performance thin-layer chromatography.

Lee, K. Y.; Poole, C. F.; Zlatkis, A.
Analytical Chemistry 52 (6) 837–842 (1980) [36 ref. En] [Dep. of Chem., Univ. of Houston, Houston, Texas 77004, USA]

An analytical method is described for the simultaneous detn. of 13 mycotoxins by high performance TLC (HPTLC). In 7 continuous multiple developments with 2 solvent systems of different polarity a base-line separation of sterigmatocystin, zearalenone, citrinin, ochratoxin A, patulin, penicillic acid, leuteoskyrin, and the aflatoxins B₁, B₂, G₁, G₂, M₁, and M₂ was obtained. About 1 h was required for the separation and quantitation of all 13 mycotoxins from one spot. By using in-situ scanning of the HPTLC plate, detection limits in the low ng range were obtained by UV-visible absorption (reflectance mode) and in the low pg range by fluorescence with a relative s.d. of 0.7–2.2% in the ng range. AS

86

Examination by Mössbauer spectroscopy of the chemical identity of iron phytate in wheat.

May, L.; Morris, E. R.; Ellis, R.
Abstracts of Papers, American Chemical Society 178 (1) AGFD 66 (1979) [En] [Catholic Univ. of America, Washington, DC 20064, USA]

When phytate is isolated from wheat bran using aqueous salt solutions, it is found to be combined with Fe and Zn when the extract is subjected to gel filtration chromatography. The isolated Fe compound is monoferric phytate. The question of the nature of the Fe (endogenous) and its relationship to the phytate was of interest. The nature of the Fe in the wheat was examined using ⁵⁷Fe Mössbauer spectroscopy. The

spectra of wheat seeds grown hydroponically using ^{57}Fe enriched culture medium and bran isolated from these seeds were compared with synthetically prepared monoferric phytate. The spectrum of the ^{57}Fe enriched wheat seeds was the same as the spectrum of the synthetic monoferric phytate. The Fe is high-spin ferric as suggested from the parameters of the Mössbauer spectrum and other spectroscopic measurements. AS

87

Mycoflora and occurrence of *Fusarium* toxins in Finnish grain.

Ylimäki, A.; Koponen, H.; Hintikka, E.-L.; Nummi, M.; Niku-Paavola, M.-L.; Ilus, T.; Enari, T.-M.

Publication, Technical Research Centre of Finland, Materials and Processing Technology No. 21, 28pp. (1979) [37 ref. En]

The study includes a mycological survey of the fungal flora occurring in 505 grain samples (barley, oats, wheat, rye) from 1976 and 1977 and chemical analyses for trichothecenes and zearalenone in 230 samples. The samples analysed were naturally contaminated with *Fusarium*, and some had been suspected of causing mycotoxicosis. Samples of grain inoculated in the field were also investigated. In the mycological study *Fusarium* spp. received special interest. The most common among 11 isolated spp. were *F. avenaceum*, *F. culmorum*, *F. arthrosporioides*, *F. tricinctum* and *F. poae*. Oats were particularly severely infected. TLC was used for detn. of the trichothecenes T2, HT2, T1 and neosolaniol. No toxins were detected in the samples studied. Zearalenone was found in 24 samples in concn. of 0.1–40.0 mg/kg. Very low amounts of T2 toxin were detected in 4 samples by gas chromatography. All the samples in which *Fusarium* metabolites could be detected had been stored without drying, and the *Fusarium* contamination in these samples was clearly higher than in samples which did not contain these compounds. LD₅₀ values, dermatotoxic effect and toxicity to U-cells were also determined. AS

88

Mycotoxins in milk and dairy products. [Review]

Lück, H.; Wehner, F. C.

South African Journal of Dairy Technology 11 (4) 169–176 (1979) [many ref. En, af] [Anim. & Dairy Sci. Res. Inst., Irene 1675, South Africa]

This review briefly outlines the biochemical reactions leading to the formation of mycotoxins, and discusses possible human health hazards resulting from mould-damaged cattle feeds (e.g. mycotoxins in milk and milk products) and from consumption of mould-contaminated or mould-ripened cheeses. Cheese appears to be a poor medium for mycotoxin formation, especially at low temp. Cheeses (such as Camembert, Brie and Blue-veined) have been consumed for many years without ill effect. The safety of these products can be ensured by using mould starter strains that do not produce toxins, and by close attention to hygiene, temp. and humidity control to ensure that contamination with mould spores does not occur. MEG

89

Penitrem A and roquefortine production by *Penicillium commune*.

Wagener, R. E.; Davis, N. D.; Diener, U. L.

Applied and Environmental Microbiology 39 (4) 882–887 (1980) [24 ref. En] [Dep. of Botany, Auburn Univ. Agric. Exp. Sta., Auburn, Alabama 36830, USA]

Cottonseed meal is widely used as a protein source in animal feeds and is potentially important as human food. Extracts of *P. commune*, a fungus isolated from cottonseed, showed biological activity in day-old cockerels. 2 neurotoxic metabolites were isolated and identified as penitrem A and roquefortine. This is the 1st report of roquefortine being produced by a fungus other than *P. roqueforti*, as well as the 1st report of penitrem A and roquefortine being produced in the same culture. Production of these toxins on liquid media and cottonseed was determined. AS

90

Production of eremofortins A, B, and C relative to formation of PR toxin by *Penicillium roqueforti*.

Moreau, S.; Lablache-Combier, A.; Biguet, J.

Applied and Environmental Microbiology 39 (4) 770–776 (1980) [14 ref. En] [INSERM U 42, Domaine du CERTIA, 59 650 Villeneuve d'Ascq, France]

Production of various eremophilane-type sesquiterpenes by *P. roqueforti* strains enables a biochemical pathway for PR toxin synthesis to be proposed. A time-course study of *P. roqueforti* metabolite production by HPLC was performed to check this hypothetical pathway. Results obtained suggest that eremofortin C is the direct precursor of PR toxin in the *P. roqueforti* cell. Attempts to determine the amount of PR toxin in mycelium failed. The absence of PR toxin in mycelium was due to its instability during the extraction procedure. AS

91

Liquid chromatographic determination of tenuazonic acids in tomato paste.

Scott, P. M.; Kanhere, S. R.

Journal of the Association of Official Analytical Chemists 63 (3) 612–621 (1980) [25 ref. En] [Health & Welfare Canada, Food Directorate, Ottawa, Ontario, Canada K1A 0L2]

Tenuazonic acid (TAA) is a mycotoxin produced by *Alternaria alternata* (*A. tenuis*) occurring in isolates from tomato. Several liquid chromatographic (LC) systems were compared for suitability in analysing it in tomato pastes. TAA was extracted from tomato paste with methanol and n-hexane and was partitioned into methylene chloride from the aqueous methanol following acidification. It was further partitioned into 5% NaHCO₃ acidified, and re-extracted with methylene chloride. LC separation of TAA from interferences was best on a C12-dien (4-dodecyldiethylenetriamine) loaded C18 reverse phase column with a mobile phase containing C12-dien, Zn(II), and ammonium acetate, or on a tetraalkylammonium anion exchange column at pH 7.5. 2 isomeric tenuazonic acids could be partially separated

in the C12-dien/metal system using acetonitrile in the mobile phase. Amounts of standard TAA as low as 2–5 ng could be detected by UV absorbance at 280 nm. Recoveries of TAA or isotenuazonic acid added to tomato paste at levels of 0.4–10 µg/g were 67–94%. Small amounts of TAA were detected in several commercial tomato pastes at levels of 0.01–0.1 µg/g. GLC/MS single ion monitoring showed that both isomers were present. AS

92

Incidence of mycotoxic molds in domestic and imported cheeses.

Bullerman, L. B.

Journal of Food Safety 2 (1) 47–58 (1980) [19 ref. En] [Dep. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, Nebraska 68583, USA]

Domestic and imported cheeses were studied to determine the incidence of mycotoxin producing moulds. The total incidence of moulds in visibly nonmouldy cheese was very low. Isolation of moulds from plate counts, and directly from samples, showed that the major portion of the flora was made up of *Penicillium* spp.; 86% in domestic cheeses and 80% in imported cheeses. Many of the *Penicillium* isolates were capable of growing at low storage temp. Mould counts done at 5°C, and prolonged storage of cheese samples at 5°C indicated a potential for considerable mould growth on cheese during refrigerated storage. While the overall incidence of known mycotoxin producing moulds was low, a number of potentially toxic spp. were found, including *P. cyclopium*, *P. viridicatum*, *Aspergillus flavus* and *A. ochraceus*. These spp. accounted for 4.4% of all the isolates from domestic cheeses and 4.0% from imported cheeses. Screening of all mould isolates for production of several known mycotoxins showed that a number of isolates (14.1% of all moulds in domestic cheeses and 11.5% in imported cheeses) were capable of producing certain mycotoxins including patulin, penicillic acid, ochratoxin A, citrinin and aflatoxins. AS

93

Determination of roquefortine in Blue cheese and Blue cheese dressing by high pressure liquid chromatography with ultraviolet and electrochemical detectors.

Ware, G. M.; Thorpe, C. W.; Pohland, A. E.

Journal of the Association of Official Analytical Chemists 63 (3) 637–641 (1980) [7 ref. En] [Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

A method is described for detn. of roquefortine in (i) Blue cheese and (ii) Blue cheese dressing. The method involves sample extraction with ethyl acetate, cleanup by liquid-liquid partition, and detn. by HPLC with UV and electrochemical detectors connected in series. Recoveries of roquefortine added to cheese at levels of 16–320 ng/g averaged 74.9%. The method was applied to analysis of 12 samples of (i) and 2 samples of (ii), all produced in the USA; roquefortine was found in all the samples at average levels of 424 ng/g for (i) and 45 ng/g for (ii). AS

94

[*Penicillium roqueforti*, its morphology, physiology, use in cheesemaking, and mycotoxins.] [Review]

Moreau, C.

Lait 60 (595/596) 254–271 (1980) [110 ref. Fr, en] [Cent. Nat. de la Recherche Sci., Lab. de Biol. Vegetale et de Microbiol., Univ. de Bretagne Occidentale – 29283 Brest Cedex, France]

This review of *P. roqueforti* begins with a brief history of its classification and nomenclature, and then describes its morphology, cultural conditions, role in cheesemaking and its occurrence as a contaminant in other dairy products, cereals, fruits, confectionery, edible oils and meat products. Mycotoxin formation (including PR toxin and other eremophilan derivatives, roquefortine, isofumigaclavins, penicillic acid, patulin and mycophenolic acid) is also discussed. These mycotoxins are not found in cheese. MEG

95

[Probable occurrence of sterigmatocystin in milk and its behaviour in cheese.] Zum wahrscheinlichen Vorkommen von Sterigmatocystin in Milch und dessen Verhalten in Käse.

Kiermeier, F.; Kraus, P.-V.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 170 (6) 421–424 (1980) [23 ref. De, en] [Tech. Univ. München, D-8050 Freising-Weiherstephan, Federal Republic of Germany]

The authors have developed a method for fluorodensitometric detn. of sterigmatocystin involving chloroform extraction, clean-up by column chromatography, application of the extract to a TLC plate, and spraying with a 20% solution of AlCl₃ in ethanol. The ketone and hydroxyl groups then form an Al complex which is 10 times more fluorescent than untreated sterigmatocystin. In tests on this method, 85.1–93.3% of 100–300 ng sterigmatocystin added to 100 ml milk was recovered. The limit for reliable detection is about 30 ng. When 100 ml milk containing 100 ng sterigmatocystin was coagulated with 10–50 mg rennet at 20–45°C, or with citric or lactic acid at pH 4.2–4.8, virtually all (89.3–99.1%) of the sterigmatocystin was found in the curd and none in the whey. The behaviour of sterigmatocystin was thus surprisingly different from that of aflatoxin M₁ [see FSTA (1977) 9 11P2029]. ADL

96

Ochratoxin A in blood from slaughter pigs in Sweden: use in evaluation of toxin content of consumed feed.

Hult, K.; Hökby, E.; Gatenbeck, S.; Rutqvist, L.

Applied and Environmental Microbiology 39 (4) 828–830 (1980) [3 ref. En] [Dep. of Biochem. & Biotech., Royal Inst. of Tech., S-100 44 Stockholm, Sweden]

Samples of pig blood, intended for ochratoxin A analysis, were collected from pigs of 279 randomly selected herds at 9 different slaughterhouses from different areas of Sweden. Pigs from 47 herds (16.8% of total) exhibited ≥ 2 ng ochratoxin A/ml blood. 1 sample each from a single pig/herd identified herds contaminated with ochratoxin A in amounts > 3 × the

detection limit of the method (3×2 ng ochratoxin A/ml blood = 6 ng/ml blood). There was a good agreement between ochratoxin A concn. in the blood from different pigs within the same herd (correlation coeff. = 0.80). Ochratoxin A concn. in pig blood was used to estimate ochratoxin A content of the consumed feed; the method showed that feed from grain produced on-farm contained higher concn. of ochratoxin A than commercial feed preparations. No geographical variation of ochratoxin A occurrence within Sweden was detected. Public health aspects of the occurrence of ochratoxin A in pig blood are discussed. From the known concn. of ochratoxin A in the blood it is possible to calculate the concn. in kidney, liver, fat and muscle. In Denmark, if the toxin concn. exceeds 10 ng/g in the kidney (equivalent to 50 ng/ml in the blood) the whole carcass of the pig is condemned. If this limit were used for the Swedish pigs represented in this investigation, 0.7% would be rejected. AL

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FAB 50

MYCOTOXINS IN FOODS (EXCLUDING AFLATOXINS & MICROBIAL TOXINS)

SELECTED FROM VOLUME 11

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of

Commonwealth Agricultural Bureaux, Farnham Royal, Bucks; Gesellschaft für Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

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Coverage of the subject has been restricted to that of Food Science and Technology Abstracts, which covers over 1200 of the important food journals, patents from 20 countries and books published world-wide. Every effort is made to include all significant references, but editorial discretion is used on the many articles of borderline interest. If the reader particularly needs an exhaustive search of the subject, we will be pleased to provide any other references that we have available. We would, in any case, encourage readers to write or telephone us with any comments or queries that they may have.

H. BROOKES

EDITOR

1

[Derivatization of patulin on a TLC plate.] Zur Derivatisierung von Patulin auf der Dünnschichtplatte. Paul, P.

Nahrung 22 (5) K21-K23 (1978) [9 ref. De] [Inst. für Exp. Epidemiologie, Wernigerode, German Democratic Republic]

For improved reliability of detn. of patulin in such products as apple juice, plum jam, or mouldy pears or peaches, the patulin may be derivatized with acetic anhydride (in pyridine) on the TLC plate before chromatography. The chromatogram is then developed with benzene/methanol/acetic acid (72:3:1). After Cl_2 treatment and spraying with benzidine solution, irradiation with long wavelength UV light reveals yellow-green fluorescent flecks of patulin acetate. Detection limit is 20 ng. IN

2

Microbial alterations of grains, legumes, and oilseeds. [Lecture]

Beuchat, L. R.

Food Technology 32 (5) 193-198 (1978) [33 ref. En] [Dep. of Food Sci., Univ. of Georgia Agric. Exp. Sta., Experiment, Georgia 30212, USA]

The detrimental effects of fungi and bacteria on stored and processed grains, legumes and oilseeds and on bakery products are first reviewed. These detrimental effects include mycotoxin formation in stored commodities, occurrence of food poisoning bacteria in processed commodities (e.g. *Bacillus cereus* in cooked rice, *Staphylococcus aureus* in pasta, and *Clostridium perfringens* in meat extended with oilseed flours, concentrates or texturized proteins) and microbial (chiefly fungal) spoilage of bakery products. Consideration is then given to the beneficial effects of fungi and bacteria in traditional fermented foods (soy sauce being taken as an example) and bakery products. A flow-sheet of soy sauce manufacture is included and tables list the following: compounds produced during fermentation and/or baking, moisture contents and water activities of various grains and oilseeds at 25-30° C, antimicrobial additives used in bakery products, information on fermented products (e.g. substrates, microorganisms, nature of products), factors affecting mycotoxin formation, and min. water activities for growth of common storage fungi at 25-30° C. [See FSTA (1979) 11 1B3]. JA

3

Annual Meeting of the American Society for Microbiology in New Orleans, Louisiana, USA, May 11, 1977. [Conference proceedings]

United States of America, American Society for Microbiology

Journal of Food Protection 41 (5) 373-408 (1978) [many ref. En]

Papers presented at a seminar held at the Annual Meeting of the American Society for Microbiology are published. The papers include: Mycotoxins - a real or potential problem - introduction, by A. W. Hayes (pp. 373-374, 3 ref.); and Fallacies in our understanding of mycotoxins, by P. B. Hamilton (pp. 404-408, 12 ref.). A further 3 papers are abstracted separately and are in the

FSTA author index under **United States of America**, American Society for Microbiology [Mycotoxin Symposium]. DIH

4

Interaction of mycotoxins with copper-folin reagent. Siraj, M. Y.; Phillips, T. D.; Hayes, A. W.

Journal of Food Protection 41 (5) 370-372 (1978) [11 ref. En] [Dep. of Pharmacology & Toxicology, Univ. of Mississippi Med. Cent., Jackson, Mississippi 39216, USA]

To study the interference by mycotoxins in protein measurements, solutions of various concn. of aflatoxin B_1 , citrinin, cytochalasin B, ochratoxin A, patulin, penicillic acid, rubratoxins A and B, T-2 toxin and zearalenone were tested for a positive copper-Folin reaction. Except for T-2 toxin, all mycotoxins tested developed a blue colour, characteristic of proteins, in the copper-Folin solution. The Lowry reaction for the mycotoxins was linear over the concn. range of 20-100 $\mu\text{g}/\text{ml}$ for most of these toxins. Aflatoxin B_1 and citrinin at 2 $\mu\text{g}/\text{ml}$ and zearalenone at 0.5 $\mu\text{g}/\text{ml}$ developed a blue colour in the copper-Folin solution. The linear relationship between colour development and toxin concn. plus high sensitivity makes the copper-Folin reaction a potential analytical method for these toxins but only in the absence of protein or other copper-Folin positive materials. AS

5

[Aflatoxins and toxigenic moulds in foods consumed in Zaire.]

Masimango, N.; Ramaut, J. L.; Remacle, J.

Revue des Fermentations et des Industries

Alimentaires 32 (6) 164-170 (1977) [14 ref. Fr, en, nl]

[Lab. de Botanique Pharmaceutique & d'Ecologie Microbienne, Univ. de Liege, Sart-Tilman, B-4000 Liege, Belgium]

Production of aflatoxin by *Aspergillus flavus* requires a temp. of 25-35° C and RH $\geq 80\%$. It is suspected that hepatic cell cancer is related to consumption of foods containing aflatoxin; such contamination varies seasonally and with altitude in the same region, a condition which exists in Zaire. Samples of basic foods were obtained from markets in various localities of Zaire and detn. were made of moisture content, aflatoxin content and mould contamination (with spp.); detailed results are tabulated for groundnut (defatted), banana, cassava, eleusine, maize flour, sorghum, potato and sweet potato. Standard AOAC methods of analysis were used, and mould cultures were examined for dry wt. of mycelium and production of aflatoxin. Of 52 samples, 47 contained moulds of which 19 (i.e. 37 %) contained aflatoxin, 5 of them with > 1 p.p.m. aflatoxin B_1 . In general, high toxin concn. was linked to high moisture content, but some inverse examples were also found. 59 mould cultures included spp. of *Aspergillus*, *Penicillium* and *Mucor*; details are tabulated for each culture of production of aflatoxins B_1 , B_2 , G_1 and G_2 , with quantitative figures for B_1 . *Aspergillus* spp. predominated but some *Asp. flavus* cultures produced no toxin. It is concluded that potential carcinogenic danger exists, and means of preventing mould proliferation in tropical climates should be sought as an urgent priority. ELC

6

A microbiological assay for penicillic acid.

Olivigni, F. J.; Bullerman, L. B.

Journal of Food Protection 41 (6) 432-434 (1978) [17 ref. En] [Dep. of Food Sci. & Tech., Univ. of Nebraska-Lincoln, Lincoln, Nebraska 68583, USA]

6 bacterial cultures were studied in a search for an organism sensitive to penicillic acid, suitable for use in a quantitative bioassay of this mycotoxin. A vegetative culture and a commercially prepared spore suspension of *Bacillus subtilis* were both sensitive to as little as 1 µg of penicillic acid and exhibited a linear relationship between 1 and 100 µg. The bioassay method was comparable in accuracy to TLC assay. The procedure was used to verify the biological activity of sample extracts, as well as to quantitate penicillic acid concn. in samples of liquid media and corn. The bioassay is sensitive, rapid (15-17 h), simple and inexpensive. AS

7

Hazards of mycotoxins to public health. [Lecture]

Wilson, B. J.

Journal of Food Protection 41 (5) 375-384 (1978) [63 ref. En] [Cent. in Toxicology, Dep. of Biochem., Vanderbilt Univ. School of Med., Nashville, Tennessee 37232, USA]

Historical aspects of the association between human disease and the presence of mycotoxins in food are briefly discussed, and the role of aflatoxins as agents of human disease is reviewed on a geographical basis, including Uganda, Taiwan, Kenya, Swaziland, Mozambique, the Philippines, S.E. Asia, Senegal and India. Contaminated cereal products were the most frequent source of aflatoxins. Contamination of milk and dairy products with aflatoxin B₁ or M₁ has been reported in South Africa and the Federal Republic of Germany. Reliable analytical methods for other mycotoxins are needed, and some substances causing disease may be unrecognized as toxins. [See FSTA (1979) 11 1C5.] DIH

8

Mycotoxins in feeds and ingredients and their origin. [Lecture]

Scott, P. M.

Journal of Food Protection 41 (5) 385-398 (1978) [19 ref. En] [Health Protection Branch, Health & Welfare Canada, Ottawa, Ontario K1A, OL2, Canada]

Incidence of mycotoxins in grains, including food grains, and consequent contamination of milk and dairy products are reviewed. Incidences of occurrence of aflatoxins in milk and milk products are tabulated for various countries, with levels found and the ref. to the original paper. Natural occurrences of toxins in grains, including some food grains, are similarly tabulated for ochratoxin A (including residues found in animal products, e.g. pig and poultry muscle), citrinin, sterigmatocystin, zearalenone and trichothecenes. Chemical structures of mycotoxins are illustrated. [See FSTA (1979) 11 1C5.] DIH

9

Trichothecenes: occurrence and toxicoses. [Lecture]

Ciegler, A.

Journal of Food Protection 41 (5) 399-403 (1978) [39 ref. En] [N. Regional Res. Cent., USDA, Peoria, Illinois 61604, USA]

Structural formulae are illustrated for some of the 37 naturally occurring Δ^9 -12,13-epoxy-trichothecenes. Fungal sources with respect to foods of the toxins are primarily *Fusarium* and *Stachybotrys*, but also *Myrothecium*, *Trichoderma* and *Cephalosporium*. Incidence and symptoms of fusariotoxicoeses in animals and man are reviewed; contaminated grain and bread have been sources of human disease. [See FSTA (1979) 11 1C5.] DIH

10

[Mycotoxins in canned vegetables and in foods of plant origin.]

Lafont, P.; Lafont, J.

Medecine et Nutrition 14 (1) 45-48 (1978) [15 ref. Fr, en] [Unite de Recherche de Toxicologie Alimentaire, INSERM, 44 Rue du Chemin de Ronde, 78110 Le Vesinet, France]

Studies were conducted on the incidence and level of contamination of canned vegetables, sweet corn, cornflour and dried soups with mycotoxins (aflatoxins, sterigmatocystin, ochratoxin, or 12-13-epoxytrichothecenes). A table of results is given. No mycotoxins were detected in any sample of canned peas (56 samples), peas + carrots (24 samples), green beans (16 samples), mixed vegetables (26 samples) or canned soup (22 samples). 1 of 43 samples of flageolets (bean seeds) contained traces of epoxytrichothecenes. 3 samples of canned salsify contained epoxytrichothecenes, at levels of 25, 40 and approx. 60 parts/billion resp. Of 42 samples of sweet corn, 2 contained traces of ochratoxin, and 2 contained epoxytrichothecenes (1 at a concn. of 25 parts/billion, the other at trace concn.). Of 36 samples of cornflour, 1 contained aflatoxin (at 2 parts/billion) and 2 contained 12-13-epoxytrichothecenes (at 30 parts/billion or at trace concn.); and, of 40 samples of dried soup, 1 contained traces of 12-13-epoxytrichothecenes. No sterigmatocystin was detected in any sample. The significance of these results is discussed in relation to the potential health hazards. AJDW

11

[Formation of luteoskyrin by *Penicillium islandicum*.]

Kim, Y.-H.; Lee, S.-R.

Korean Journal of Food Science and Technology 10 (1) 46-51 (1978) [26 ref. Ko, en] [Environmental Chem. Lab., Korea Atomic Energy Res. Inst., Seoul, S. Korea]

The yellow rice toxin, luteoskyrin, was investigated with respect to its identification, quantitation and reproducibility by *Penicillium islandicum* isolated from deteriorated rice. Luteoskyrin was best resolved by TLC with a silica gel G plate impregnated with 0.5N oxalic acid and acetone:n-hexane:water (6:3:1.5, upper layer) solvent system. The isolated yellow spot showed max. absorption bands at 426 and 448 nm and changed to a purple colour upon exposure to sunlight for 2-3 h. Detection limit for luteoskyrin was 4 p.p.m. in

elution-colorimetry and 0.1 p.p.m. in densitometry after TLC. Assuming that the tolerance for luteoskyrin in rice is set below 3.68 p.p.m., densitometry is suitable for screening grain samples. Reproducibility of luteoskyrin by *P. islandicum* was shown to be 11 mg/g mycelial mat in liquid culture and 40 mg/g in autoclaved rice. AS

12

Fate of patulin during alcoholic fermentation of apple juice.

Stinson, E. E.; Osman, S. F.; Bills, D. D.

Abstracts of Papers, American Chemical Society 176, AGFD 22 (1978) [En] [E. Regional Res. Cent., USDA, 600 E. Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

Patulin is a mycotoxin produced in high yields by a number of food-contaminating fungi, including *Penicillium expansum*, an important cause of storage rot of apples. 10 yeast strains were used in 3 typical US commercial procedures to ferment apple juice containing added patulin. In all cases the level of patulin was reduced by > 99% during alcoholic fermentation. Use of [¹⁴C]patulin revealed that the products were largely non-volatile and water soluble. Use of a model system showed that the reaction of patulin with sulphhydryl groups would play, at most, a minor role in the disappearance of patulin during fermentation. AS

13

[Effects of the contamination of spices in the food industry.]

Moreau, C.; Moreau, M.

Industries Alimentaires et Agricoles 95 (5) 497-502 (1978) [19 ref. Fr, de, en] [Fac. des Sci & Tech, Univ. de Bretagne Occidentale, Brest, France]

Mycological analysis of samples from recently imported spices revealed extensive contamination of pepper, especially white pepper. ≤ 14 spp. were detected, chiefly of *Aspergillus*, and > 1 million/g of viable organisms. The least contamination was found in garlic, Spanish pimentos and Chinese cayenne pepper (1-3 spp. 0.03-1.3 x 10³ viable organisms/g). The risk of mycotoxin formation in foods prepared with mould infected spices and some disinfection methods are discussed, of which irradiation is the most promising. RM

14

Aflatoxin is degraded by fragmented and intact mycelia of *Aspergillus parasiticus* grown 5 to 18 days with and without agitation.

Doyle, M. P.; Marth, E. H.

Journal of Food Protection 41 (7) 549-555 (1978) [28 ref. En] [Dep. of Food Sci. & the Food Res. Inst., Univ. of Wisconsin-Madison, Madison, Wisconsin 53706, USA]

Mycelia of *Aspergillus parasiticus* NRRL 2999 degraded aflatoxins B₁ and G₁. Initially 9-day-old mycelia appeared to degrade both aflatoxins effectively; however, later experiments indicated that rates at which 9-day-old mycelia degraded aflatoxins B₁ and G₁ varied even though the mycelia were produced and evaluated under similar conditions. A comparison of the ratio of rates at which mycelia of different ages

degraded aflatoxins B₁ and G₁ suggests that more than one mechanism may be involved in degradation of aflatoxin by the mould. Mycelia produced when incubation was quiescent or with agitation degraded aflatoxins B₁ and G₁. Fragmenting of mycelia greatly increased their ability to degrade aflatoxin, thus suggesting that the degrading factor(s) is/are intracellular constituent(s) of the mycelium. AS

15

[Foodstuffs as a source of toxic compounds.]

Pyysalo, H.

Kemia-Kemi 5 (9) 377-379 (1978) [11 ref. Fi, en]

Although there are frequent cases of food-borne illness the number of serious cases in Finland/yr is very low. Most of the cases result from pathogenic bacteria. The most important enterotoxins in Finland are thought to be produced by *Staphylococcus aureus*, *Clostridium perfringens* and *Bacillus cereus*. The chief mycotoxins are aflatoxins and patulin. The most important pollutants in the Finnish diet are heavy metals, chlorinated phenols and polychlorinated biphenyls. The level of pesticides residues in Finnish foodstuffs is low. In this paper a short survey is made of the harmful compounds potentially present in foodstuffs. AS

16

Mycotoxin producing fungi. [Lecture]

Ayres, J. C.

International Congress of Food Science & Technology - Abstracts p.95 (1978) [En] [Food Sci. Dep., Univ. of Georgia, Athens, Georgia 30602, USA]

Certain strains of common field and storage fungi are able to synthesize potent toxins and/or carcinogens. Most belong to the genera *Aspergillus*, *Penicillium*, *Fusarium*, *Alternaria*, *Byssoschlamys*, *Trichothecium*, *Cladosporium*, *Sclerotinia* and *Claviceps*. Characterization of the fungi and their mycotoxins is discussed, together with problems encountered in crops grown under unfavourable conditions. Feasibility of current tolerances and suggested limits are appraised. Also, recent advances in methodology are evaluated. [See FSTA (1979) 11 2A60.] SP

17

Microflora in the industrially produced dough.

[Lecture]

Zakula, R.; Todorovic, M.

International Congress of Food Science & Technology - Abstracts p.262 (1978) [En] [Fac. of Tech., Dep. of Food Microbiol., Novi Sad Univ., 21000 Novi Sad, Yugoslavia]

15 semi-prepared dough products containing various fillings were examined in an attempt to establish the microorganisms present in these products and the effects of low temp. (4° C for 24, 48 and 72 h) and of cooking temp. on the microbial flora. Mycotoxin-producing moulds were among the organisms isolated. [See FSTA (1979) 11 2A60.] JA

18

[Moulds and mycotoxins in spontaneously mouldy bread.]

Andersson, A.; Josefsson, E.; Nilsson, G.; Akerstrand, K.

Var Föda 30 (3) 109-114 (1978) [18 ref. Sv, en]
[Livsmedelslab., Statens Livsmedelsverk, 751 26
Uppsala, Sweden]

19 samples of white bread and 24 samples of brown bread were stored in plastics bags for 2 or 3 wk at room temp. After 2 wk, 16 samples of white bread and 9 samples of brown bread were found to be mouldy; after 3 wk, all samples of white and 16 samples of brown bread were mouldy. Predominant moulds detected were *Penicillium verrucosum* var. *cyclopium* (in 14 samples), *Penicillium expansum* (in 12), *Aspergillus niger* (in 11), and *Asp. flavus* (in 6). Other moulds detected included *Neurospora* sp., *Paecilomyces* sp., *Penicillium brevicompactum* and *Penicillium roqueforti* (in 2 samples each); and *Asp. glaucus*, *Asp. versicolor*, *Aureobasidium* sp., *Mucor* sp., *Rhizopus* sp., *Penicillium chrysogenum*, *Penicillium janthinellum* and *Ulocladium* sp. (in 1 sample each). The moulds and adjacent bread were tested for aflatoxins, patulin, ochratoxin A, sterigmatocystin and zearalenone. Only 1 sample contained any mycotoxin: samples from a white loaf stored for 2 wk (showing growth of *Penicillium expansum*) contained patulin. No patulin was detectable in samples from the same loaf after storage for 25 days. AJDW

19

Identification of roquefortine C produced by *Penicillium roqueforti*.

Ohmomo, S.; Utagawa, T.; Abe, M.
Agricultural and Biological Chemistry 41 (10)
2097-2098 (1977) [8 ref. En] [Lab. of Ind. Microbiol.,
Tokyo Univ. of Education, Komaba, Meguro-ku, Tokyo,
Japan]

Production of roquefortine C (ROQ-C), which was isolated as a minor alkaloid in previous experiments [see *Agricultural and Biological Chemistry* (1975) 39 (6) 1333-1334], was favoured by increasing the incubation temp. to 30° C. Culture filtrate obtained after incubation of *P. roqueforti* at 30° C for 20 days in a mannitol/glucose/succinic acid medium was purified to give a yield of ROQ-C in crystalline form of 600 mg/20 l. culture. ROQ-C was compared with the roquefortine described in FSTA (1976) 8 12P2309 and found to be virtually identical in structure and m.p. CDP

20

[Action of sorbic acid against mycotoxin producing microorganisms.] Zur Wirkung von Sorbinsäure gegen Mykotoxinbildner.

Wallhäusser, K. H.; Lück, E.
Zeitschrift für Lebensmittel-Untersuchung und -Forschung 167 (3) 156-157 (1978) [7 ref. De, en]
[Hoechst Aktiengesellschaft, D-6230 Frankfurt/Main,
Federal Republic of Germany]

Growth of 4 strains of *Aspergillus versicolor* that produced sterigmatocystin was inhibited by sorbic acid in culture media at pH 5.9 and 5.7 at 400-800 p.p.m. and 200-800 p.p.m., resp. The corresponding figures for a strain of *A. niger* were 1600 and 800 p.p.m. Raw fermented sausages were infected with *A. versicolor*, and the effects of a dip in 15% potassium sorbate were studied; untreated sausages were mouldy within

6-9 days, treated sausages remained free of mould for 4 wk. DIH

21

Mycotoxin producing potential of fungi associated with dry shrimps.

Wu, M. T.; Salunkhe, D. K.
Journal of Applied Bacteriology 45 (2) 231-238 (1978)
[23 ref. En] [Dep. of Nutr. & Food Sci., Utah State Univ.,
Logan, Utah 84322, USA]

Among 114 fungi isolated from 20 dry shrimp samples, 27 isolates were capable of producing mycotoxins. *Aspergillus* and *Penicillium* were the predominant fungi. 2 of 3 *Aspergillus flavus* could produce aflatoxin B₁ and G₁ on yeast extract sucrose medium and on surface sterilized dry shrimps. For other toxigenic spp., toxicity was found mostly in the chloroform extracts of cultures. Visibly mouldy dry shrimps had significantly higher moisture content than the non-mouldy ones. Most of the fungi were isolated from mouldy samples. It was concluded that keeping the moisture content of dry shrimps low is the best way of preventing mould growth on these products. AS

22

[Foods - moulds - mycotoxins.] Lebensmittel - Schimmel - Schimmelpilzgifte.

Frank, H. K.
Verbraucherdienst, B 22 (10) 217-220 (1977) [De]
[Bundesforschungsanstalt für Ernährung, Karlsruhe,
Federal Republic of Germany]

Aspects discussed include: the toxicity of mycotoxins; toxigenic moulds; sources of contamination with moulds; growth conditions required by toxigenic moulds; conditions for mycotoxin formation; products in which mycotoxins have been detected; the significance of mycotoxins in feeds; legal aspects; and consumer precautions. AJDW

23

Bioproduction of ¹⁴C-ochratoxin A in submerged culture.

Lillehoj, E. B.; Aalund, O.; Hald, B.
Abstracts of the Annual Meeting of the American Society for Microbiology 78, 183 (1978) [En] [N.
Regional Res. Cent., USDA, Peoria, Illinois 61604, USA]

A number of *Aspergillus* and *Penicillium* spp. were tested for production of ochratoxin A (OA) in several liquid media. After 10-day static incubations at 28° C, toxin yields of 25 µg/ml and 30 µg/ml were obtained with *A. alliaceus* NRRL 4181 in Raulin-Thom and in yeast extract (2%)/sucrose (4%) media, resp. However, the largest production observed in the preliminary screening was 50 µg OA/ml; this level was produced by *A. sulphureus* NRRL 4077 in a modified Czapek's solution. The medium contained basal salts and sucrose, plus urea (3%) and corn steep liquor (0.5% solids). A time study of toxin production demonstrated max. yield of 300 µg OA/ml by the *A. sulphureus* isolate in modified Czapek's medium after 11 days of static incubation at 28° C. The optimal production conditions were employed in tests designed to measure the efficiency of ¹⁴C incorporation from sodium

[1-¹⁴C]acetate into OA. Sodium [1-¹⁴C]acetate was added to separate culture flasks at 24-h intervals during the initial 9 days of the fermentation. Addition of the C-1 labelled substrate on the 4th day of incubation provided max. yield of labelled OA. The highest average specific activity was 22.5 nCi/mol. and the max. incorporation rate was 4.5%. AS

24

[Microflora of commercial crumb.]

Ichinoe, M.; Hayashi, T.; Norizuki, H.

Bulletin of the National Institute of Hygienic Sciences [Eisei Shikenjo Hokoku] 95, 92-95 (1977) [5 ref. Ja, en] [Nat. Inst. of Hygienic Sci., Tokyo, Japan]

Microorganisms associated with 30 samples of commercial crumb were examined. The number of mould colonies isolated from the samples averaged 1847/g, and ranged 2×10^1 to 2.7×10^4 /g. 18 of the samples obtained averaged 7732/g and ranged from 10 to 8.4×10^4 /g colonies of yeasts. The major fungi isolated were *Aspergillus glaucus*, *A. restrictus*, *A. candidus*, *A. versicolor*, *Penicillium cyclopium*, *P. puberulum*, *Cladosporium*, *Paecilomyces* and *Wallemia*. 17 of the samples contained total bacteria at > 300 colonies/g, and 4 had $> 1.8 \times 10^4$ /g. No culture of coliform bacteria was found. Isolates of *Aspergillus flavus* and *A. versicolor* were grown on yeast extract-sucrose broth (YES) at 25°, for 1-2 wk, and analysed for mycotoxins using TLC. 20 isolates of *A. flavus* were tested for the production of aflatoxins. A single *A. flavus* strain produced aflatoxins in small amounts. Of 10 isolates of *A. versicolor*, 9 were shown to produce sterigmatocystin on YES-medium. AS

25

Patulin production during storage of blackcurrant, blueberry and strawberry jams inoculated with *Penicillium expansum* mould.

Lindroth, S.; Niskanen, A.; Pensala, O.

Journal of Food Science 43 (5) 1427-1429, 1432 (1978) [12 ref. En] [Tech. Res. Cent. of Finland, Food Res. Lab., Biologinkuja 1, SF-02150 Espoo, Finland]

The effects of storage temp., water activity (a_w) and a CO₂ rich atmosphere on patulin production by *Penicillium expansum* in blackcurrant, blueberry and strawberry jams were studied over a storage period of 6 months. Reduction of storage temp. from 22° to 4° C resulted in decreases both in hyphal growth and patulin production. An atmosphere containing 10% CO₂ had the effect of reducing patulin synthesis but did not significantly affect fungal growth. When the a_w of stored jam was reduced by the addition of 20 or 44% sugar, toxin production in the jams was reduced to a level of 1/10-1/1250 of the max. occurring in unsweetened jam [i.e. boiled fruit], despite the fact that the addition of sugar stimulated hyphal growth. Max. concn. of patulin were usually observed after 1-2 months of storage, after which the toxin level fell significantly. IFT

26

Evaluation of *Sclerotinia sclerotiorum* as a mycotoxin producer on soybeans.

Ciegler, A.; Purbridge, K.; Hesseltine, C. W.

Abstracts of the Annual Meeting of the American Society for Microbiology 78, 184 (1978) [En]

[N. Regional Res. Cent., USDA, Peoria, Illinois, USA]

S. sclerotiorum is responsible for celery pickers disease via production of toxic psoralens in infected plants. This fungus can also infect soybeans, producing large black sclerotia and causing stem rot although invasion of the bean is unusual. Psoralen occurrence in naturally infected soybeans or plants has not been reported. Sclerotia and soybeans from a contaminated shipload were analysed for psoralens and other potential toxins, using TLC and biological assays with negative results. Mice refused sclerotia when given it as their sole source of diet. Soybeans were inoculated with 10 strains of *S. sclerotiorum* and incubated for 2 wk. Various solvent extracts were negative for psoralens but were lethal to mice and chick embryos. Intubation of these extracts into mice resulted in no deaths thereby casting doubt on the toxicological import of those substances that might be produced during *S. sclerotiorum* infection of soybeans. AS

27

High pressure liquid chromatography of zearalenone in cereals.

Möller, T. E.; Josefsson, E.

Journal of the Association of Official Analytical Chemists 61 (4) 789-792 (1978) [10 ref. En] [Swedish Nat. Food Administration, Food Lab., S-751 26 Uppsala, Sweden]

A high pressure liquid chromatographic method was developed for determining zearalenone in cereals. The sample is extracted with phosphoric acid and chloroform. The extract is cleaned up by washing on a silica gel column with benzene/hexane or cyclohexane/ethylene dichloride/ethyl ether and eluting with chloroform, and further purified by extracting into alkaline solution, washing with water, adjusting pH, and back-extracting into chloroform. Zearalenone is determined by using a liquid chromatograph with 2 columns in series packed with Spherisorb 10 µm ODS and with a UV detector set at 236 nm. The detection limit of the methods is 2 µg/kg. Recovery is about 90% when benzene/hexane is used in the washing step, and about 80% when cyclohexane/ethylene dichloride/ethyl ether is used. AS

28

Gas-liquid chromatographic determination of T-2 toxin and diacetoxyscirpenol in corn and mixed feeds.

Romer, T. R.; Boling, T. M.; MacDonald, J. L.

Journal of the Association of Official Analytical Chemists 61 (4) 801-808 (1978) [15 ref. En] [Ralston Purina Co., Checkerboard Square, St. Louis, Missouri 63188, USA]

A GLC method was developed for the simultaneous detn. of T-2 toxin and diacetoxyscirpenol (DAS) in corn and mixed feeds. The analytes are extracted with aqueous methanol. (NH₄)₂SO₄ is used to denature and precipitate proteinaceous compounds and to salt out low polar compounds. The analytes are selectively concentrated into chloroform, which is washed with aqueous KOH to remove acidic compounds. Residual

interferences are removed by silica gel column chromatography. Heptafluorobutrylimidazole (HFB) is added to form esters of the analytes. The HFB-esters are separated on an SE-30 glass column and measured with a ^{63}Ni electron capture detector, using methoxychlor as an internal standard. The method was applied to corn and feed. The limit of detection is 100 ng T-2 toxin and 25 ng DAS/g. Average recoveries of 105 and 97% and coeff. of variation of 17 and 10% were obtained for T-2 toxin and DAS, resp. AS

29

Mycotoxic fungi, mycotoxins, mycotoxicoses. Vol. 1. Mycotoxic fungi and chemistry of mycotoxins.

[Book]

Wyllie, T. D.; Morehouse, L. G. (Editors)
xxiv + 538pp. ISBN 0-8247-6550-8 (1977) [many ref. En]
New York, USA; Marcel Dekker, Inc. Price FS230.00
[Dep. of Plant Path., Coll. of Agric., Univ. of Missouri-Columbia, Columbia, Missouri, 65201 USA]

This handbook contains 2 main sections: Mycology of mycotoxic fungi (pp. 1-128), giving a key to toxigenic fungi, and subsections covering the genera *Aspergillus*, *Penicillium*, *Fusarium*, *Claviceps*, *Stachybotrys*, *Pithomyces*, *Phoma*, *Myrothecium*, *Phomopsis* and *Diplodia*; and Chemistry of mycotoxins (pp. 131-469), covering aflatoxin and related compounds, coumarin and related compounds, *Penicillium* toxins, tremorgenic mycotoxins, *Fusarium* and *Stachybotrys* toxins, *Claviceps* mycotoxins, sporidesmins, slaframine, toxins of *Phoma herbarum* var. *medicaginis*, and *Myrothecium* toxins. A 9-pp. glossary, a 41-pp. author index to the references quoted, and a 16-pp. subject index are also included. AJDW

30

Production of xanthomegnin and viomellein by isolates of *Aspergillus ochraceus*, *Penicillium cyclopium*, and *Penicillium viridicatum*.

Stack, M. E.; Mislivec, P. B.

Applied and Environmental Microbiology 36 (4) 552-554 (1978) [20 ref. En] [Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

Fungal isolates from dried pinto beans and split peas were cultured on rice and examined for production of the toxic mould metabolites xanthomegnin (XAN) and viomellein (VIO). 6 of 14 *Aspergillus ochraceus* isolates produced 0.3-1.3 mg XAN/g and 0.1-1.0 mg VIO/g. 1 of 9 isolates of *Penicillium cyclopium* produced 0.1 mg XAN/g and 0.06 mg VIO/g. 3 of 9 *P. viridicatum* isolates produced 0.4-1.6 mg XAN/g and 0.2-0.4 mg VIO/g. This is the first report of XAN and VIO production by *A. ochraceus* and *P. cyclopium*. AL

31

Distribution of ochratoxin A in chicken tissues and eggs.

Frye, C. E.; Chu, F. S.

Journal of Food Safety 1 (2) 147-159 (1977) [23 ref. En] [Dep. of Food Microbiol. & Toxicology, Food Res. Inst., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

The kinetics of distribution of ochratoxin A (OA) in chicken tissues was studied. Day-old chicks were fed a

starter diet alone or containing 1 p.p.m. OA. After 5 wk, all chicks were intubated with 50 μg ^3H -OA/chick. The highest level of radioactivity was found in kidney and liver 8 h after intubation. Peak levels of OA in kidney, liver and breast were found to be 12, 4, and 0.2 parts/billion (p.p.b.) resp. Over 90% of the radioactivity was eliminated 48 h after intubation. Moreover, when laying hens were fed a diet containing 0.5 or 5.0 p.p.m. of OA for 2 wk, the highest levels of OA were also found in the kidney (124 p.p.b.) and liver (80 p.p.b.). Levels of OA in breast, leg and eggs of laying hens were found to be 8, 7, and 2.8 p.p.b. resp. AS

32

Disappearance of patulin during alcoholic fermentation of apple juice.

Stinson, E. E.; Osman, S. F.; Huhtanen, C. N.; Bills, D. D. *Applied and Environmental Microbiology* 36 (4) 620-622 (1978) [17 ref. En] [E. Regional Res. Cent., Fed. Res. Sci. & Education Administration, USDA, Philadelphia, Pennsylvania 19118, USA]

8 yeast strains were used in 3 typical American processes to ferment apple juice containing 15 mg of added patulin/l. Patulin was reduced to less than the min. detectable level of 50 μg /l. in all but 2 cases; in all cases, the level of patulin was reduced by >99% during alcoholic fermentation. In unfermented samples of apple juice, the concn. of added patulin declined by only 10% when the juice was held for 2 wk, a period equivalent to the time required for fermentation. AS

33

[A new method for determination of the mycotoxin patulin with thin layer or high pressure liquid chromatography.] Neue Bestimmungsmethode des Mykotoxins Patulin mit Hilfe der Dünnschicht- und Hochdruckflüssigchromatographie.

Leuenberger, U.; Gauch, R.; Baumgartner, E.

Journal of Chromatography 161, 303-309 (1978) [11 ref. De, en] [Kantonales Lab., Postfach, CH-3000 Bern 9, Switzerland]

A new method for detn. of patulin in fruit juices that requires less labour and extraction solution than present methods is described. Aqueous samples (e.g. apple juice) are extracted by passing through a column of Extrelut (Merck). Patulin is eluted from the Extrelut column with toluene/ethyl acetate (3:1) and freed of contaminating substances by passing the eluate through a silica gel column. Concentrated eluate is dissolved in ethyl acetate, evaporated to dryness and redissolved in ethyl acetate for detn. by high pressure liquid chromatography (HPLC) or TLC. HPLC detn. is on a $\mu\text{Bondapak-CN}$ column, with gradient elution using a mixture of (i) n-hexane and (ii) 5% 1-butanol in dichloromethane; 10-50% (ii) in a slightly convex gradient. Patulin is detected by UV at 275 nm. TLC detn. of patulin is carried out on silica gel plates developed in n-hexane/dichloromethane/butanol (55:45:9). Detection and quantitation is by reflectance spectrometry at 420 nm after spraying with 2-hydrazono-2,3-dihydro-3-methylbenzothiazolehydrochloride. The extraction process gives recoveries of $97 \pm 4\%$ for 50 parts/10⁹ added patulin; relative s.d. of detn. is for HPLC $\pm 4\%$ and for TLC $\pm 6\%$. Limits of sensitivity are 5 and

20 parts/10⁹, resp. Details of an on-plate acetylation TLC confirmation test are given; this is suitable for confirmation of patulin when present at an original concn. of > 50 parts/10⁹. DIH

34

Kojic acid synthesis by resuspended mycelia of *Aspergillus flavus*. (In 'Proceedings of the Sixth Joint Convention' [see FSTA (1979) 11 4L225]) [Lecture] Pratima Bajpai; Agrawal, P. K.; Viswanathan, L. G17-G23 (1977) [11 ref. En] [Nat. Sugar Inst., Kanpur, Uttar Pradesh, India]

Aspergillus flavus mycelia, grown on a sucrose/yeast extract medium for 4 days, were washed with sterile, distilled water, and resuspended in 0.2M phosphate buffer (pH 6.5) containing 20% sucrose or glucose. Approx. 1.75 g mycelia in 50 ml buffer produced 2.15 g kojic acid in 7 days. CFTRI

35

Effect of clarification of molasses on kojic acid fermentation. (In 'Proceedings of the Sixth Joint Convention' [see FSTA (1979) 11 4L225]) [Lecture] Pratima Bajpai; Agrawal, P. K.; Viswanathan, L. G25-G37 (1977) [17 ref. En] [Nat. Sugar Inst., Kanpur, Uttar Pradesh, India]

A resuspended, non-toxin producing strain of *Aspergillus flavus* produced low amounts of kojic acid on molasses clarified by chemical and ion-exchange methods; clarification by egg albumin slightly increased the yield. Supplementation of molasses (both clarified and unclarified) with 1% yeast extract increased kojic acid yield (max. 277%) and also reduced the fermentation time by 2-3 wk. CFTRI

36

[Spectrophotofluorometric method for determination of ochratoxin A in cereals.]

Czerwieski, L.

Roczniki Panstwowego Zakladu Higieny 29 (4) 389-394 (1978) [20 ref. Pl, ru, en] [Zaklad Badania Zywnosci i Przedmiotow Uzytku Panstwowego Zakladu Higieny, Warsaw, Poland]

A spectrophotofluorometric method for detn. of ochratoxin A in wheat and rye is described. The method is based on toxin extraction from the sample with chloroform, with addition of phosphoric acid. The extract obtained is purified on a Celite 545 column. After developing the thin-layer chromatogram, ochratoxin spots fluorescing in UV light at about 365 nm are eluted with ethanol. The intensity of fluorescence is measured spectrophotofluorometrically. For determining the level of ochratoxin, a standard curve in ethanol is plotted. The limit of detection of the method is 15 µg ochratoxin A/kg of wheat or rye. Recovery ranges from 47.56 to 63.84%, depending on the fortification level; the accuracy, expressed as coefficient of variability V, is 4.60-9.90%. AS

37

Ochratoxin A: Isolation [from fermented wheat] and subsequent purification by high-pressure liquid chromatography.

Peterson, R. E.; Ciegler, A.

Applied and Environmental Microbiology 36 (4) 613-614 (1978) [9 ref. En] [N. Regional Res. Cent., Fed. Res., Sci. & Education Administration, USDA, Peoria, Illinois 61604, USA]

38

Zearalenone: distribution in wet-milling fractions from contaminated corn.

Bennett, G. A.; Vandegraft, E. E.; Shotwell, O. L.; Watson, S. A.; Bocan, B. J.

Cereal Chemistry 55 (4) 455-461 (1978) [22 ref. En] [N. Regional Res. Cent., USDA, Peoria, Illinois 61604, USA]

3 samples of corn naturally contaminated with zearalenone (0.9, 4.1 and 9.4 p.p.m.) were wet-milled and the distribution of zearalenone was studied. % of zearalenone recovered in each fraction (and concn. found, dry basis) was: germ 9.1-10.9 (1.7-7.5 p.p.m.), starch 0 (< 0.1 p.p.m.), fibre 14.7-19.0 (2.7-6.8 p.p.m.), gluten 48.8-56.3 (6.8-20.4 p.p.m.) and solubles 17.4-26.3 (3.9-10.6). Total recoveries of zearalenone were 142, 52, and 45%, resp. for increasing levels of contamination. The most heavily contaminated grains had increased fibre and gluten yields and lowered starch and germ yields. % of zearalenone recovered in gluten + solubles were 71.9-75.1%. Zearalenone was stable to steeping in lactic acid or SO₂ solutions, and was quantitatively recovered from spiked gluten preparations. DIH

39

[Evaluation of the hygienic state of flour: hygienic considerations.]

Aureli, P.; Cerquetti, M.; Lorch, L. von

Rivista della Societa Italiana di Scienza dell'Alimentazione 7 (2) 135-140 (1978) [27 ref. It] [Istituto Superiore di Sanita, Rome, Italy]

Studies were conducted on the microbiological quality of 100 samples of commercial wheat flours. Diagrams are given showing distributions of counts of aerobic mesophiles, thermophiles, moulds, and spores of mesophiles, and a table of values is given for coliform counts. The results show counts of spoilage microorganisms and/or of organisms indicating faecal contamination were relatively high in some samples; all samples were, however, free from pathogens. Studies on moulds from the flours revealed that 20% had UV fluorescence characteristics suggestive of toxigenicity. The potential for direct testing for mycotoxins (using *Bacillus stearothermophilus* as a test organism) is considered. The results are discussed in relation to the hygienic quality and evaluation of flour. It is suggested that mould growth could be controlled by reduction of the moisture content of the flour. AJDW

40

Natural occurrence of trichothecenes (nivalenol, deoxynivalenol, T₂) and zearalenone in corn.

Jemmali, M.; Ueno, Y.; Ishii, K.; Frayssinet, C.; Etienne, M.

Experientia 34 (10) 1333-1334 (1978) [6 ref. En] [Service Mycotoxines, INRA, 16 Rue Nicolas Fortin, F-75013 Paris, France]

Corn samples were extracted with methanol, lipids were removed from the extract by washing with hexane,

the extract was evaporated to dryness and the residue was re-extracted with methanol/chloroform (1:5). The soluble fraction was analysed by sequential TLC and GLC for mycotoxins (shown to be present by rat skin bioassay). Max. amounts of toxins found were zearalenone 10 p.p.m., nivalenol 4.28 p.p.m., deoxynivalenol 0.6 p.p.m., and T₂ toxin 0.02 p.p.m. DIH

41

Determination of zearalenone in corn by high pressure liquid chromatography and fluorescence detection.

Ware, G. M.; Thorpe, C. W.

Journal of the Association of Official Analytical Chemists 61 (5) 1058-1062 (1978) [17 ref. En] [FDA, Div. of Chem. & Physics, Washington, DC 20204, USA]

A method is reported for determining zearalenone in corn at levels as low as 10 ng/g. Samples are extracted with chloroform/water and cleaned up by liquid-liquid chromatography, and the zearalenone is detected by a fluorescence detector after separation by reverse phase high pressure liquid chromatography (HPLC). Recoveries of zearalenone added to corn at levels from 10 to 200 ng/g averaged >89%. In addition, a confirmation procedure is described which involves sequential HPLC analysis of the sample and a zearalenone standard, using 4 different excitation wavelengths and comparing fluorescence responses obtained. This method was successfully applied to the analysis of 11 samples of cornmeal; zearalenone was detected in 9 of the samples, at levels from 11 to 69 ng/g. AS

42

Isolation, purification, and antibiotic activity of o-ethoxycinnamaldehyde from cinnamon.

Morozumi, S.

Applied and Environmental Microbiology 36 (4) 577-583 (1978) [48 ref. En] [Dep. of Microbiol., Tokyo Metropolitan Res. Lab. of Public Health, Shinjuku-ku, Tokyo, 160 Japan]

o-Methoxycinnamaldehyde was isolated and purified from powdered cinnamon. The compound inhibits the growth and toxin production of mycotoxin-producing fungi. It completely inhibited the growth of *Aspergillus parasiticus* and *A. flavus* at 100 µg/ml and *A. ochraceus* and *A. versicolor* at 200 µg/ml. It inhibited the production of aflatoxin B₁ by >90% at 6.25 µg/ml, ochratoxin A at 25 µg/ml, and sterigmatocystin at 50 µg/ml. It also displayed a strong inhibitory effect on the growth of 5 dermatophytes spp., e.g. *Microsporum canis* (min. inhibitory concn. 3.12-6.25 µg/ml). However, no antibacterial effect was observed at concn. as high as 50 µg/ml. AS

43

[Natural and other toxic materials in food.]

Ammon, R.

Elelmezsi Ipar 32 (9) 328-335 (1978) [Hu, en, de, ru] [Univ. des Saarlandes Physiol.-Chem. Inst., 6650 Homburg, Federal Republic of Germany]

Aspects considered in this discussion of toxic materials in food include: pollen-derived toxic materials

in honey; poisonous fungi; cyanides; tetrodotoxin in fugu fish; dinoflagellate toxins in shellfish; *Clostridium botulinum* toxin; staphylococcal toxin; mycotoxins; monoamine oxidase inhibitors and their interaction with dietary amines; allergens; F; As; Pb; Hg; Cd; DDT; and biphenyl. AJDW

44

Mycotoxins in human and animal health.

[Conference proceedings]

Rodricks, J. V.; Hesseltine, C. W.; Mehlman, M. A. (United States-Japan Natural Resources Program) (Editors)

xvii + 807pp. ISBN 0-930376-00-5 (1977) [many ref. En] Park Forest South, Illinois, USA; Pathotox Publishers, Inc. [FDA, Washington, DC 20204, USA]

The published proceedings of the symposium provide a comprehensive review and assessment of the status of mycotoxin research. The proceedings are divided into the following subject areas: Aflatoxins; Trichothecenes and other fusarium toxins; Zearalenone; Other mycotoxins of possible health significance; Biomedical assessment of mycotoxin risks; and Regulation and marketplace. Papers in the Aflatoxin section include Introduction, by K. Aibara (p. 6); Aflatoxins - an overview, by L. Stoloff, (pp. 7-28, 72 ref.); Aflatoxin residues from contaminated feed in edible tissues of food-producing animals, by J. V. Rodricks & L. Stoloff (pp. 67-79, 34 ref.); Biosynthesis of aflatoxin and its control, by T. A. Venkatasubramanian (pp. 83-98, 62 ref.); Aflatoxin occurrence and control during growth, harvest and storage of peanuts, by J. W. Dickens (pp. 99-105, 18 ref.); Aflatoxin control during plant growth and harvest of corn, by E. B. Lillehoj & C. W. Hesseltine (pp. 107-119, 26 ref.); Aflatoxin control during food processing of peanuts, by P. J. Tiemstra (pp. 121-137, 13 ref.); Detoxification of contaminated crops, by L. A. Goldblatt & F. G. Dollear (pp. 139-150, 58 ref.); Influence of plant genetics on colonization by *Aspergillus flavus* and toxin production (peanuts), by A. C. Mixon (pp. 163-172, 25 ref.); and Influence of plant genetics on toxin production in corn, by M. S. Zuber (pp. 173-179, 7 ref.). Papers in the Trichothecene section include Introduction, by H. Kurata (p. 187); Trichothecenes: overview address by Y. Ueno (pp. 189-207, 84 ref.); Chemistry and biosynthesis of trichothecenes, by C. Tamm (pp. 209-228, 81 ref.); Assay methods for trichothecenes and review of their natural occurrence, by S. V. Pathre & C. J. Mirocha (pp. 229-253, 47 ref.); and Comparative toxicities of trichothecenes, by N. Sato & Y. Ueno (pp. 295-307, 36 ref.). [Contd. in following abstr.] DIH

45

Mycotoxins in human and animal health.

[Conference proceedings]

Rodricks, J. V.; Hesseltine, C. W.; Mehlmann, M. A. (United States-Japan Natural Resources Program) (Editors)

xvii + 807pp. ISBN 0-930376-00-5 (1977) [many ref. En] Park Forest South, Illinois, USA; Pathotox Publishers, Inc. [FDA, Washington, DC 20204, USA]

[Contd. from preceding abstr.] Papers in the Zearalenone section include Introduction, by

C. W. Hesseltine (pp. 341-344); Zearalenone [including structure, properties, biosynthesis, occurrence and analysis], by C. J. Mirocha, S. V. Pathre & C. M. Christensen (pp. 345-364, 71 ref.); and Assay methods for zearalenone and its natural occurrence, by O. L. Shotwell (pp. 403-413, 42 ref.). Papers in the Other mycotoxins section include Introduction, by M. Manabe (p. 417); Mycotoxins, excluding aflatoxin, zearalenone and the trichothecenes, by P. S. Steyn (pp. 419-467, many ref.); Toxigenic fungi in foods [especially soybeans, beans and peppercorns], by P. B. Mislivec (pp. 469-477, 24 ref.); Ochratoxins, by P. Krogh (pp. 489-498, 34 ref.); Rubratoxins, by A. W. Hayes (pp. 507-523, 54 ref.); Metabolites of *Penicillium viridicatum*, by M. E. Stack, R. M. Eppley & A. E. Pohland (pp. 543-555, 42 ref.); and Patulin, by A. Ciegler [including occurrence of patulin-producing fungi on foods] (pp. 609-624, many ref.). Papers in the Biomedical assessment section include Introduction, by S. Matsuura (p. 663); Newer approaches in assessment of environmental carcinogenesis, by H. F. Kraybill (pp. 675-686, 19 ref.); Role of metabolic studies in evaluation of mycotoxin health risks, by T. C. Campbell [including mention of problems of metabolite residues in meat, milk or eggs] (pp. 687-698, 25 ref.); and Role of epidemiology in the elucidation of mycotoxin health risks, by S. J. van Rensburg [which is concerned with human disease outbreaks caused by mycotoxin-contaminated food] (pp. 699-711, 24 ref.). Papers in the Regulation and marketplace section are Introduction, by F. R. Senti (p. 751); Mycotoxin regulation in the United States, by J. V. Rodricks & H. R. Roberts (pp. 753-757); Aflatoxin regulation by T. W. Edminster (pp. 765-771); and The FAO program and mycotoxins, by K. O. Herz (pp. 773-777). Also included are a summary of papers presented, by F. R. Senti (pp. 779-789) and a 17 pp. subject index. A further 10 papers are abstracted separately (including recommendations of panel discussions) and are in the FSTA author index under United States-Japan Natural Resources Program [Mycotoxins Symposium]. DIH

46

Long-term testing of patulin administered orally to Sprague-Dawley rats and Swiss mice. Osswald, H.; Frank, H. K.; Komitowski, D.; Winter, H. *Food and Cosmetics Toxicology* 16 (3) 243-247 (1978) [18 ref. En] [Inst. für Toxikologie & Chemotherapie, Heidelberg, Federal Republic of Germany]

A long-term experiment (64 wk) was carried out in which twice weekly doses totalling 358 mg patulin/kg were administered by stomach pump to rats, to investigate the possible carcinogenic action of the mycotoxin. Possible transplacental action of patulin given orally to mice during the last third of pregnancy was also investigated. No carcinogenic action attributable to patulin administration was observed. Despite these negative findings, it is stressed that the potential danger of producing pulp or juices from more or less rotten fruit must be recognized. VJG

47

Rubratoxins: detection and purification, bioproduction and biosynthesis. Emeh, C. O.

Dissertation Abstracts International, B 37 (10) 4883: Order No. 76-29909 (1977) [En] [Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

Solvent extraction (using diethyl ether, ethyl acetate plus benzene and ethyl alcohol) together with TLC, column chromatography and UV spectrophotometry were found suitable for recovering rubratoxins from various substrates. *Penicillium rubrum* 1062, 2120, 2123 and 3290 all produced rubratoxins A and B in soy whey fortified with malt extract, while *P. rubrum* 13 produced only rubratoxin B. Toxin yield increased with time of incubation (but declined rapidly after 17 days) and malt extract concn. Rubratoxins were recovered from experimentally contaminated soybean substrates, max. amounts being yielded by low-fat soy meal, soy whey and soybeans fortified with malt extract or glucose. Further studies examined rubratoxin biosynthesis, its production in various semi-synthetic and natural media (including corn, rice, orange juice and grapefruit juice) and chemical stimulation and inhibition of rubratoxin production. JA

48

Citrinin mycotoxicosis in the Syrian hamster.

Jordan, W. H.; Carlton, W. W.; Sansing, G. A. *Food and Cosmetics Toxicology* 16 (4) 355-363 (1978) [18 ref. En] [Dep. of Vet. Microbiol. & Pathol., School of Vet. Med., Purdue Univ., W. Lafayette, Indiana 47907, USA]

A description is given of the acute toxicity of the mycotoxin, citrinin, in the Syrian hamster. The mycotoxin was dissolved in either dimethylsulphoxide and 50% ethanol or 0.5N sodium hydroxide and was administered by the intraperitoneal and oral routes. Lesions in hamsters given single or multiple doses of citrinin were primarily found in the kidneys. Renal lesions in hamsters given multiple doses of citrinin were no more severe than those found in hamsters given only a single dose. VJG

49

Panel on trichothecene toxins. (In 'Mycotoxins in human and animal health' [see FSTA (1979) 11 5C268]) [Lecture]

Smalley, E.; Joffe, A.; Palyusik, M.; Kurata, H.; Marasas, W. pp. 337-340 (1977) [En] [Dep. of Plant Path., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

Research topics are recommended as being important in the clarification of the role of trichothecenes in alimentary toxic aleukia. Topics include improvement of taxonomy of trichothecene-producing *Fusarium* spp., clarification of causal factors in trichothecene toxicoses, control of trichothecene mycotoxins, surveying foods for trichothecene-producing fungi, toxicological characterization studies, improvement of assay methods, and detn. of metabolites of trichothecenes in farm animals. DIH

50

Panel on zearalenone. (In 'Mycotoxins in human and animal health' [see FSTA (1979) 11 5C268]) [Lecture] Balzer, I.; Ozegovic, L.; Tutie, J.; Scott, P. pp. 415-416 (1977) [En] [Fac. of Agric., Simunski 25,

41000 Zagreb, Yugoslavia]

Recommendations are made about fruitful areas of zearalenone research, including production of surveys of foods for *Fusarium* and other zearalenone producers, detn. of environmental conditions necessary for production of zearalenone on foods and detn. of the fate of the mycotoxin during food processing. Studies of residues in animal tissues such as meat, milk and eggs should be carried out, and possible synergism of toxicity with other mycotoxins should be investigated. Chemical control methods and analytical methods require development. DIH

51

Mycotoxin production of fungi on commercial foods. (In 'Mycotoxins in human and animal health' [see FSTA (1979) 11 5C268]) [Lecture]
Hitokoto, H.; Morozumi, S.; Wauke, T.; Sakai, S.; Kurata, H.
pp. 479-487 (1977) [En] [Dep. of Microbiol., Tokyo Metropolitan Res. Lab. of Public Health, 24-1, Hyakunin-cho, 3-chome, Shinjuku-ku, Tokyo, 160 Japan]

The ability of 27 different foods to support fungal growth and mycotoxin production was investigated. Foods were studied in (i) their natural state (dried powder or fresh as appropriate), (ii) after immersion in water for 4 h (made up to 40% moisture for dried foods) or (iii) as a suspension of 10 g food + 90 ml water. Foods were inoculated separately with strains of *Aspergillus parasiticus*, *A. versicolor*, *A. ochraceus* or *Fusarium solani* that produced aflatoxin, sterigmatocystin, ochratoxin A or T-2 toxin + diacetoxyscirpenol, resp., on liquid media. All inoculated samples were incubated at 25° C for 8-30 days and were then monitored for mycotoxin content and fungal growth. Dried sweet potato and salami were the most favourable foods for fungal growth and mycotoxin production, the 1st 3 named being produced in the natural state. The only other (i) food to support mycotoxin (sterigmatocystin) production was dried persimmon. Growth and mycotoxin production is tabulated for each food, organism and moisture condition. Foods examined include cereal noodles, beans and seeds, sea foods, spices and dried skim-milk. No mycotoxin production under any conditions was noticed on pepper seed, roasted coffee bean or cinnamon; a chloroform extract from pepper seed or cinnamon inhibited growth of the 4 fungi. DIH

52

Panel on other mycotoxins of possible health significance: Recommendations for further research. (In 'Mycotoxins in human and animal health' [see FSTA (1979) 11 5C268]) [Lecture]

Wilson B.; Austwick, P.; Diener, U.; Sreenivasamurthy, V.; Matsuura, S.
pp. 655-661 (1977) [En] [Vanderbilt Univ. School of Med., Nashville, Tennessee 37232, USA]

Recommendations made on areas of research on mycotoxins presenting threats to human health by contaminating food include development of analytical techniques and studies of occurrence, toxicity, etc. of

tremorgenic toxins, and penicillic acid, citrinin and ochratoxin A; improvements in analytical techniques for rubratoxins and metabolites of *Penicillium viridicatum*; studies of incidence of patulin in foods; and surveys and development of improved analytical techniques for monitoring food contamination by aflatoxins, sterigmatocystin, toxic metabolites of *P. islandicum* and *Aspergillus versicolor*, presenting particular problems in Japan. DIH

53

High pressure liquid chromatographic determination of patulin in apple juice.

Stray, H.

Journal of the Association of Official Analytical Chemists 61 (6) 1359-1362 (1978) [5 ref. En] [Food Inspection of Processed Fruits & Vegetables, Min. of Agric., Gladengvn SB, Oslo 6, Norway]

Patulin was extracted from apple juice with ethyl acetate and the extract was purified by elution from a silica gel column with ethyl acetate/toluene. The eluate was concentrated, and patulin was determined by reverse phase high pressure liquid chromatography using a 25 cm Partisil-10 ODS column. The lower detection limit was 1 µg/l. and the mean recovery of patulin added to apple juice was 82.6 ± 2.8% at levels of 10-240 µg/l. The patulin content ranged from <1 to 220 µg/l. for the 140 samples analysed. AS

54

Distribution of aflatoxin and/or zearalenone in wet-milled corn products: a review. [Review]

Bennett, G. A.; Anderson, R. A.

Journal of Agricultural and Food Chemistry 26 (5) 1055-1060 (1978) [39 ref. En] [N. Regional Res. Cent., USDA, Peoria, Illinois 61604, USA]

The occurrence of aflatoxins and zearalenone in corn is reviewed and their significance for the wet milling process is considered. Analytical techniques suitable for detn. of mycotoxins in wet-milled corn products are described. Results of experiments are described in which naturally and artificially contaminated corn was wet-milled, and the distribution of mycotoxin among the milling fractions studied. Corn containing aflatoxin from natural or artificial contamination (120 and 638 parts/billion, resp.) on wet milling gave approx. 40% of original contamination in steepwater and solubles, approx. 50% in fibre and gluten and 1% in starch (the food fraction). Zearalenone contamination (900-9400 parts/billion) was also concentrated in feed fractions rather than starch. DIH

55

Ochratoxin A in retail flour.

Richardson, E. A.; Flude, P. J.; Patterson, D. S. P.; Mackenzie, D. W. R.; Wakefield, E. H.

Lancet 2(8104/5) 1366 (1978) [En] [Public Health Lab. Service, Poole, Dorset, UK]

Flour delivered to a school in the Bournemouth area was found by TLC to contain ≤6.25 mg ochratoxin A/kg. *Penicillium cyclopium*, a fungus known to produce this toxin, was found in discoloured portions of the caked flour. Ochratoxin was also found

in a 2nd sack delivered to the school, but not in samples of sound flour or in 6 samples of flour of varying quality from other sources. The health risk did not appear to be serious. AS

56

Determination of citrinin in corn and barley.

Marti, L. R.; Wilson, D. M.; Evans, B. D.

Journal of the Association of Official Analytical Chemists 61 (6) 1353-1358 (1978) [22 ref. En] [Dep. of Plant Path., Univ. of Georgia, Coastal Plain Exp. Sta., Tifton, Georgia 31794, USA]

A method is described for determining citrinin in corn and barley. The initial extraction uses an aqueous acidified acetonitrile solution, and the resulting solution is partially purified by several partition steps. Citrinin is determined by using either high pressure liquid chromatography (HPLC) or TLC. For HPLC, the extract is injected on a reverse phase column, eluted with either 0.25N H_3PO_4 /methanol (45 + 55) or 0.25N H_3PO_4 /acetonitrile (50 + 50), and detected by fluorescence (excitation 325-385 nm, emission above 451 nm). Recovery of added citrinin from corn by this method is 60-86% at levels of 50-4000 $\mu\text{g/kg}$. For TLC, the chromatographic plates are impregnated with oxalic acid by dipping them in an oxalic acid/methanol solution before spotting and development. Recovery of added citrinin from corn, using TLC, is 40-100% at levels of 50-4000 $\mu\text{g/kg}$. AS

57

Mycotoxins in foodstuffs. XII. The influence of the water activity (a_w) of cakes on the growth of moulds and the formation of mycotoxins.

Reiss, J.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 167 (6) 419-422 (1978) [19 ref. En, de] [Mikrobiol. Lab. der Grahamhaus Studt KG, D-6550 Bad Kreuznach, Federal Republic of Germany]

The influence of various a_w values (high, moderate and low, e.g. 0.92, 0.87, and 0.82) of cakes ('Rührkuchen', made of wheat flour, sugar, eggs, fat and water) on the development and the mycotoxin production of *Aspergillus flavus* (aflatoxins), *A. versicolor* (sterigmatocystin), *A. ochraceus* (ochratoxin A), *Penicillium chrysogenum* (citrinin) and *P. expansum* (patulin) was investigated. None of the moulds was able to germinate at an a_w of 0.82. An increase of the water activity resulted in a pronounced growth of the 5 fungi. Citrinin was not formed on the cakes at all. The yields of the other mycotoxins were not markedly influenced by the a_w (0.92 or 0.87). During the development of the moulds the a_w of the substrate was lowered at first (water requirement during germination and initial growth) and subsequently increased (initiation of the secondary metabolism). [See FSTA (1978) 10 6M475 for part X.] AS

58

Trichothecenes from mold-infested cereals in Japan.

(In 'Mycotoxins in human and animal health' [see FSTA (1979) 11 5C268]) [Lecture]

Yoshizawa, T.; Morooka, N.

pp. 309-321 (1977) [En] [Fac. of Agric., Kagawa Univ., Kagawa, Japan]

Isolation, elucidation of structure and detn. of biological activity of trichothecenes from infected barley and from a pure culture of a toxic isolate of *Fusarium roseum* are described. Deoxynivalenol and nivalenol were isolated from *Fusarium*-infected barley in yields of 5-7 mg/kg barley. An isolate of *F. roseum* from the barley was cultured on (i) synthetic media or (ii) rice grains. (i) yielded deoxynivalenol and its monoacetate (3 α -acetoxy-7 α ,15-dihydroxy-12,13-epoxytrichothec-9-en-8-one). (ii) yielded deoxynivalenol, 3-acetyldeoxynivalenol and diacetyldeoxynivalenol, in amounts of 100, 400 and 10 mg/kg rice after 10-12 days at 25° C. Toxicity studies on rats and mice are reported for deoxynivalenol and its 3-acetyl and 3,15-diacetyl derivatives. DIH

59

Toxins from a strain involved in ATA [alimentary toxic aleukia]. (In 'Mycotoxins in human and animal health' [see FSTA (1979) 11 5C268]) [Lecture]

Yagen, B.; Joffe, A. Z.; Horn, P.; Mor, N.; Lutsky, I. I. pp. 329-336 (1977) [En] [The Hebrew Univ. of Jerusalem, Jerusalem, Israel]

Metabolites were isolated from cultures of *Fusarium sporotrichioides* 921, a strain isolated from rye grains involved in a fatal human case of ATA. The strain was cultivated on millet at 12° C, and metabolites were extracted by ethanol and studied by TLC, GLC, GLC-MS, and NMR and IR spectrometry. Compounds extracted were methyl esters of fatty acids, presumably from the millet substrate; 6 steroids, none of which were toxic or skin irritants (total 0.15 g/kg millet); T-2 toxin, 4.1 g/kg millet; and small quantities of solanin and HT-2 toxin (0.025 and 0.030 g/kg millet). 106 isolates of *F. sporotrichioides* and 25 isolates of *F. poae*, all associated with clinical ATA cases were also studied; 95% produced T-2 toxin. It is concluded that ATA intoxication associated with contaminated grain is primarily caused by T-2 toxin poisoning. Results of comparative toxicity trials on cats of pure T-2 toxin and extract from *F. sporotrichioides* 921 are presented. DIH

60

Miscellaneous *Penicillium* toxins. (In 'Mycotoxins in human and animal health' [see FSTA (1979) 11 5C268]) [Lecture]

Leistner, L.; Pitt, J. I.

pp. 639-653 (1977) [En] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

442 *Penicillium* isolates from 44 fermented sausages from 11 countries were studied for toxinogenesis, identity of toxins produced, sp. of toxigenic isolates and factors governing mycotoxin formation, 324 (73.3%) of the strains were toxigenic by chemical or biological assay, when the strains were grown in yeast extract-sucrose (YES) medium. 110 (24.9%) of the isolates synthesized identifiable mycotoxins on YES medium; 8 toxins were found. Some organisms produced > 1 toxin, e.g. patulin + citrinin or patulin + penicillic acid. 95 strains that produced

identifiable mycotoxins were identified to sp.; 14 spp. were represented, predominantly *P. cyclopium* (41 isolates), *P. verrucosum* (13) and *P. crustosum* (11). Mycotoxin synthesized and sp. associated with a particular mycotoxin depended on country of origin of the sausage. > 324 strains may have been toxigenic, as some strains that produced cyclopiazonic acid on ML medium did not produce it on the YES medium used for toxinogenicity studies. Influences of sausage components, pH and moisture on mycotoxin production, stability and recovery are discussed and reviewed. Freedom of mould-fermented meat products from mycotoxins is possible only with use of fully toxicologically tested starter cultures (e.g. *P. nalgiovensis*) and exclusion of contaminating mould spp. DIH

61

Detection of penicillic acid in foods.

Neelakantan, S.; Theymoli Balasubramanian; Balasaraswathi, R.; Indira Jasmine, G.; Swaminathan, R. *Journal of Food Science and Technology, India* 15 (3) 125-126 (1978) [7 ref. En] [Dep. of Food Tech., Tamil Nadu Agric. Univ., Coimbatore-641 003, Tamil Nadu, India]

2 new colour reagents have been developed for visualizing penicillic acid on TLC plates. p-tolualdehyde reagent gives a phlox purple colour and p-dimethylaminobenzaldehyde reagent gives a chrome yellow colour. The presence of $\geq 0.25 \mu\text{g}$ penicillic acid could be detected. CFTRI

62

Mycotoxicosis produced in rats by cultural products of an isolate of *Aspergillus ochraceus*.

Zimmermann, J. L.; Carlton, W. W.; Tuite, J. *Food and Cosmetics Toxicology* 16 (5) 449-461 (1978) [47 ref. En] [Dep. of Vet. Microbiol., Path. & Public Health, School of Vet. Med., Purdue Univ., W. Lafayette, Indiana 47907, USA]

A description is given of the mycotoxicosis produced in rats fed diets containing a rice culture or fungal mat of *A. ochraceus* for 5 wk. The ground rice culture was mixed with a commercial purified diet at concn. of 5, 7.5 and 10% and the fungal mat at concn. of 1, 2 and 3%. VJG

63

Citrinin mycotoxicosis in the rat. I. Toxicology and pathology.

Jordan, W. H.; Carlton, W. W.; Sansing, G. A. *Food and Cosmetics Toxicology* 16 (5) 431-439 (1978) [18 ref. En] [Dep. of Vet. Microbiol. & Path., School of Vet. Med., Purdue Univ., W. Lafayette, Indiana 47907, USA]

In a series of 4 trials, citrinin was administered by the intraperitoneal route as a single dose or in daily doses to determine its acute toxicity for the rat. The nephrotoxic effect of citrinin was revealed by gross and histopathological alterations. VJG

64

Citrinin mycotoxicosis in the rat.

II. Clinicopathological observations.

Jordan, W. H.; Carlton, W. W.; Sansing, G. A. *Food and Cosmetics Toxicology* 16 (5) 441-447 (1978) [15 ref. En] [Dep. of Vet. Microbiol. & Path., School of Vet. Med., Purdue Univ., W. Lafayette, Indiana 47907, USA]

See preceding abstr.

65

Molds, mycotoxins, and mycotoxicoses.

Christensen, C. M.; Mirocha, C. J.; Meronuck, R. A. *Cereal Foods World* 22 (10) 513-516, 518-520 (1977) [4 ref. En] [Dep. of Plant Path., Univ. of Minnesota, St. Paul, Minnesota 55108, USA]

Some of the salient features of the more common mycotoxins and mycotoxicoses are summarized under the headings: Fusarium toxins and toxicoses (zearalenone and the estrogenic syndrome, T-2 toxin and other trichothecenes, refusal factor and vomitoxin); aflatoxin and aflatoxicoses (the fungus, aflatoxin production, competing microflora, high aflatoxin risk crops, durability and potency of aflatoxin, ochratoxin); ergot and ergotism; and corn smut. Symptoms in animals caused by consumption of toxic feeds are diagnosed, and means of controlling them suggested. VJG

66

Analytical approaches to the trichothecene mycotoxins.

Romer, T. R. *Cereal Foods World* 22 (10) 521-523 (1977) [6 ref. En] [Nutritional Biochem. Lab., Ralston Purina Co., St. Louis, Missouri 63188, USA]

Some approaches to detecting the presence of Fusarium trichothecenes in cereal grains are discussed. These include the rabbit skin test and chemical detection of the epoxide ring. Characteristics of the trichothecene mycotoxins are presented and the magnitude of their threat to the cereal industry is considered. VJG

67

Mycotoxins in foods and feeds - their detection, estimation, preventive and curative measures.

[Review]

Pruthi, J. S.

Bulletin of Grain Technology 16 (1) 51-68 (1978) [60 ref. En] [Cent. Food Tech. Res. Inst, Exp. Sta., Ludhiana-6, Punjab, India]

The review discusses the following topics: survey of aflatoxin contamination; contamination of food grains and of peanut oil; human health hazards; animal health hazards; isolation and characterization of aflatoxins; detection and estimation techniques; factors affecting aflatoxin formation; preventive or control measures (drying, use of fumigants/fungicides, hermetic storage and controlled atmosphere, radiation); and methods of

detoxification (criteria for detoxification; physical separation; air separation; mechanical/electrical sorting; effect of heat by solvent extraction; chemical inactivation, reaction with NH_3 , reaction with methylene/ H_2O_2 , ozonization, microbiological method; alkali refining and bleaching of vegetable oils). CFTRI

68

Mycotoxins - corn-related problems.

Shotwell, O. L.

Cereal Foods World 22 (10) 524-527 (1977) [En] [USDA, Northern Regional Res. Cent., Peoria, Illinois 61604, USA]

Consideration is given to the mycotoxins causing most concern in corn, namely, aflatoxins, zearalenone, trichothecenes and ochratoxins. The incidence, levels and methods of detn. of the mycotoxins are examined. Ways of monitoring corn for aflatoxin and of detoxifying aflatoxin-contaminated corn are discussed. VJG

68

[Survey of aflatoxin and ochratoxin A in French maize of 1973 and 1974.]

Galtier, P.; Jemmali, M.; Larrieu, G.

Annales de la Nutrition et de l'Alimentation 31 (3) 381-389 (1977) [many ref. Fr, en] [INRA, 180 Chemin de Tournefeuille, 31 300 Toulouse, France]

924 samples of maize harvested in 1973 and 1974 were analysed for aflatoxin and ochratoxin A. Tabulated results showed 1 sample (0.1%) with aflatoxin, and 18 samples (1.9%) with > 15 parts/billion ochratoxin A (6 samples with 120-200 parts/billion). The known ochratoxinogenic strain *Aspergillus ochraceus* was isolated. The toxin concn. was considered to be too low to cause acute or toxic mycotoxicosis (due mainly to dilution with uncontaminated grain). RM

69

Evaluation of *Sclerotinia sclerotiorum* as a potential mycotoxin producer on soybeans.

Ciegler, A.; Burbridge, K. A.; Ciegler, J.; Hesseltine, C. W.

Applied and Environmental Microbiology 36 (3) 533-535 (1978) [9 ref. En] [N. Regional Res. Cent., USDA, Peoria, Illinois 61604, USA]

Studies on the potential for formation of mycotoxins by *Sclerotinia sclerotiorum* in soybeans are described. Sclerotia from contaminated batches were extracted with organic solvents; no psoralens were detectable by TLC. Solvent extracts of the sclerotia were non-toxic to mice or chicken embryos, applied intraperitoneally or per os. Plating of sclerotia and soybeans of 2 contaminated batches showed no growth of *S. sclerotiorum*. No psoralens were formed by *S. sclerotiorum* cultured on soybeans; extracts of these cultures were, however, lethal when applied intraperitoneally to mice or to the air sac of chicken embryos. Chlorinated hydrocarbons were detected in the extracts; these may be responsible for the lethal effects. No toxicity of oral administration of extracts from the inoculated soybeans was observed. It is

concluded that there is no significant risk of mycotoxicosis from soybeans contaminated with *S. sclerotiorum*. AJDW

70

Patulin - problems and prevention.

Beer, S. V.

Special Report, New York State Agricultural Experiment Station No. 27, 5-7 (1978) [En] [Dep. of Plant Path., Cornell Univ., Ithaca, New York, USA]

Patulin is a mycotoxin (a semi-lactone) found in apple juice and cider made from fruit decayed by *Penicillium expansum*, and is considered an apple juice contaminant. Experiments are described in which artificially contaminated apples were kept in controlled temp. and atmospheres; controlled atm as used for normal apple storage reduced patulin formation but not decay rates. Some handling methods and procedures for minimizing patulin contamination of apple juices and ciders are discussed. JRR

71

[Occurrence of the mycotoxin patulin in fruit and fruit products.] Zum Vorkommen des Mykotoxins Patulin in Obst und Obstprodukten.

Meyer, R. A.

Lebensmittel-Industrie 25 (5) 224-225 (1978) [13 ref. De, en, fr, ru] [Bezirks-Hygieneinspektion & Inst., Dresden, German Democratic Republic]

Studies on patulin conc. in apples, apple products and other fruit products are described. Patulin was determined by the author's TLC method [FSTA (1977) 9 7H1151]. Patulin was detected in 84% of 274 apple juice samples studied over the period 1975-1977. On average, 16% of these samples contained < 20 µg patulin/l., 59% contained 20-99 µg/l., 20% contained 100-399 µg/l., and 5% contained ≥ 400 µg/l. Apples with brown rot contained ≤ 25 000 µg patulin/kg. 9 of 23 samples of mouldy apple juice contained patulin at a level of ≤ 80 000 µg/l. Patulin was detected in only a few of 64 apple sauce samples, at levels ≤ 50 µg/kg. Low conc. of patulin were also detected in samples of pear, grape and quince juices. Potential for control of growth and patulin formation by *Penicillium expansum* on apples is discussed. IN

72

Patulin production by some fungal species in relation to water activity and temperature.

Northolt, M. D.; Egmond, H. P. van; Paulsch, W. E.

Journal of Food Protection 41 (11) 885-890 (1978) [25 ref. En] [Lab. for Zoonoses & Food Microbiol., Nat. Inst. of Public Health, Bilthoven, Netherlands]

Combined effects of water activity (a_w) and temp. on growth and patulin production by strains of *Penicillium expansum*, *P. patulum*, and *Aspergillus clavatus* were determined. Malt agar media were used, in which the a_w was adjusted by addition of sucrose or glycerine. Min. a_w values for patulin production by *P. expansum*, *P. patulum*, and *A. clavatus* were 0.99, 0.95 and 0.99, resp. Temp. ranges for patulin production by *P. expansum*, *P. patulum*, and *A. clavatus* were 0-24°, 4-31°, and 12-24°C, resp. Optimum temp. for patulin

production by *P. expansum* and *A. clavatus* were low compared with those for growth. Optimum temp. for patulin production at high a_w by *P. patulum* varied with the strain tested and were 8° or 31°C. The temp. range for patulin production in apples by *P. expansum* was determined. Min. temp. for rotting and patulin production were 1°C in Cox Orange cv. and 4°C in Golden Delicious cv. Amount of patulin accumulating in rotten tissue of 6 apple var. differed greatly [The var. in order of patulin concn. found at 8°C were: Golden Delicious, Cox Orange <Notaris, Ingrid Marie <Goudreinette, Jonathan]. The invasiveness of and patulin production by various strains of 4 patulin-producing fungal spp. were tested. All *P. expansum* strains tested caused rot containing patulin. Increase of rot and patulin production by *P. crustosum* and *A. clavatus* depended on the strains tested. None of the *P. patulum* strains was able to invade Golden Delicious apples. AS

73

Survey of 1977 crop year preharvest corn for vomitoxin.

Vesonder, R. F.; Ciegler, A.; Rogers, R. F.; Burbridge, K. A.; Bothast, R. J.; Jensen, A. H.
Applied and Environmental Microbiology 36 (6) 885-888 (1978) [5 ref. En] [N. Regional Res. Cent., USDA, Peoria, Illinois 61604, USA]

52 preharvest corn samples were collected in mid-Oct. 1977 from 26 farms in a 4-county area of northwest Ohio. Vomitoxin ranging from 0.5 to 10 µg/g was found in 24 of the samples. Analysis for vomitoxin was by GLC. Preceding harvest, unusual wet conditions prevailed, making it favourable for *Fusarium* growth. *Gibberella zeae*-infected kernels ranged from 2 to 50% of the kernels analysed for 44 corn samples; 8 corn samples showed no infection. AS

74

Determination of zearalenone in corn by laser fluorimetry.

Diebold, G. J.; Karny, N.; Zare, R. N.
Analytical Chemistry 51 (1) 67-69 (1979) [18 ref. En] [Dep. of Chem., Stanford Univ., Stanford, California 94305, USA]

Combining laser fluorimetry with high pressure liquid chromatography enabled the detection and quantitation of the naturally fluorescent mycotoxin, zearalenone, in contaminated corn samples. Experiments with zearalenone standards showed a linear fluorimeter response over 4 orders of magnitude with a detection limit of 300 pg zearalenone injected onto a C18 reverse phase column. The corn samples were first purified using a small silica gel column; recovery from this step was 86% over the range from 5 parts/billion to 2.5 p.p.m. Based on the magnitude of the zearalenone signals compared to the flatness of the base line for zearalenone-free corn samples, a limit of 5 parts/billion is placed on the detection of zearalenone by this procedure. AS

75

[Mycotoxins in cheese.] Zur Frage der Mykotoxine in Käse. [Review].

Sieber, R.

Schweizerische Milchzeitung 104 (92) 683-684; (96) 714 (1978) [73 ref. De] [Eidgenössische Forschungsanstalt für Milchwirtschaft, Liebefeld-Bern, Switzerland]

This review-type article deals with distribution of milk aflatoxin M₁ during cheesemaking; its behaviour during ripening and storage; its presence in ripe cheese; means of avoiding contamination of cheese with aflatoxin M₁; factors determining mycotoxin formation; model experiments on mycotoxin formation in cheese; and incidence of mycotoxins in cheese. It is concluded that contamination of cheese by aflatoxin M₁ may be avoided by ensuring its absence from cattle feeds; and that there is no danger of mycotoxin formation in cheese in storage at ≤ 16°C and 72-78% RH under good care conditions. SKK

76

[Determination of the potential for mycotoxin contamination of pasta products.]

Stoloff, L.; Trucksess, M.; Anderson, P. W.; Glabe, E. F.; Aldridge, J. G.

Tecnica Molitoria 29 (11) 793-797 (1978) [22 ref. It, en] [Bureau of Foods, FDA, Washington, DC 20204, USA]

See FSTA (1978) 10 9M884 for original En version.

77

Ochratoxin A as the cause of spontaneous nephropathy in fattening pigs.

Rutqvist, L.; Björklund, N.-E.; Hult, K.; Hökby, E.; Carlsson, B.

Applied and Environmental Microbiology 36 (6) 920-925 (1978) [19 ref. En] [Dep. of Biochem. & Biotech., Nat. Vet. Inst., S-104 05 Stockholm, Sweden]

At a number of slaughters nephropathy and high ochratoxin A contents in kidneys were observed in fattening pigs from 2 Swedish farms. In 1 herd the source of contamination was home-grown barley stored under such conditions that the growth of *Penicillium verrucosum* var. *verrucosum* producing ochratoxin A occurred, with subsequent formation of the toxin. High ochratoxin A levels in fattening pigs were found during a period of about 18 months. In the 2nd herd, contamination was presumed to be from a consignment of compounded feed damaged by rain during storage at the farm. Ochratoxin A was found in fattening pigs for about 2 months. Ochratoxin A appeared in the kidneys of all investigated pigs. In some animals the livers, whole blood, and plasma were also analysed. Livers contained somewhat lower amounts of ochratoxin A than kidneys, whereas the content in whole blood and plasma, resp. was 5 and 13 times greater. Kidneys spontaneously contaminated with ochratoxin A, when stored for 10 months at -70°C, showed no systematic decrease in toxin content. AS

78

[Effect of water activity (a_w value) on aflatoxin and patulin formation.] Bildung von Aflatoxinen und Patulin in Abhängigkeit von der Wasseraktivität. Löttsch, R.; Trapper, D.

Fleischwirtschaft 58 (12) 2001-2007; 1975 (1978) [43 ref. De, en] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

10 toxigenic strains of *Aspergillus flavus*, *A. parasiticus* and *Penicillium griseofulvum* were examined for growth and toxin formation on various semi-synthetic media at $a_w > 0.99$ to 0.80. Growth and toxin concn. were determined at 4-day intervals during 16 days incubation. Tabulated results showed that aflatoxin-producing moulds were still able to grow at a_w 0.82, patulin-producers at 0.84. Aflatoxin and patulin formation was observed to a_w 0.82 and 0.88 resp. The toxin formation was not always parallel to the growth curve, so that the risk of mycotoxin contamination of foods is better estimated from the a_w value than from the amount of mould growth. Other factors (temp., time, strain, substrate components and pH) also affect the mycotoxin concn. Application of the results of these model experiments to intermediate-moisture foods (IMF) shows that aflatoxin presents a greater risk than patulin, though no aflatoxin formation need be expected at $a_w < 0.80$ even without fungistatic agents. RM

79

Instability of PR toxin in Blue cheese.

Scott, P. M.; Kanhere, S. R.

Journal of the Association of Official Analytical Chemists 62 (1) 141-147 (1979) [23 ref. En] [Health & Welfare Canada, Food Directorate, Health Protection Branch, Ottawa, Ontario, Canada K1A 0L2]

PR toxin was unstable in solvent extracts of Blue cheese and in strongly acidic solutions. However, it was relatively stable over a 2.5 h period in moderately acidic methanol/water extracts (pH 2.3) of Blue cheese. Using this extraction mixture, it was determined that PR toxin was not stable in Blue cheese itself. PR toxin reacted with model neutral and basic amino acids and the formation of PR imine from PR toxin in the presence of Blue cheese was demonstrated. While PR imine added to Blue cheese could be recovered on analysis after 5 min, over a 2-5 day period it too was unstable in the cheese. [Assessment of possible toxicological hazard from PR toxin should take into account possible reaction products in the cheese as a whole.] AS

80

Acute toxicity studies on roquefortine and PR toxin, metabolites of *Penicillium roqueforti* in the mouse.

Arnold, D. L.; Scott, P. M.; McGuire, P. F.; Harwig, J.; Nera, E. A.

Food and Cosmetics Toxicology 16 (4) 369-371 (1978) [13 ref. En] [Bureau of Chem. Safety, Food Directorate, Health Protection Branch, Health & Welfare Canada, Ottawa, Ontario, Canada K1A 0L2]

The acute toxicities of (i) PR toxin and (ii) roquefortine, 2 metabolites of *Penicillium roqueforti*, were determined in both sexes of 2 strains of mice following intraperitoneal (ip) administration. (i) was found to be more toxic on an acute basis than (ii)

following ip administration. Reacting with L-leucine or L- α -alanine or converting it to the imine greatly reduced its acute ip toxicity. Some of the acute toxicity of the PR-toxin analogues (imine, L- α -alanine or L-leucine) seen in this study may be attributable to the small ($\leq 2\%$) residue of (i). It may be speculated that most or all of (i) produced by *P. roqueforti* during the maturation of blue cheese would react with amino compounds present to produce derivatives similar to those studied here. As these derivatives are much less toxic than (i), it appears that the potential toxicological hazard from (i) would thus be reduced. VJG

81

Isolation of a new indole alkaloid, roquefortine D, from the cultures of *Penicillium roqueforti*.

Ohmomo, S.; Oguma, K.; Ohashi, T.; Abe, M.

Agricultural and Biological Chemistry 42 (12) 2387-2389 (1978) [7 ref. En] [Inst. of Applied Biochem., Univ. of Tsukuba, Ibaraki-ken 300-31, Japan]

A previously unknown alkaloid isolated from cultures of *P. roqueforti* was crystallized, and its physical and chemical properties were studied. It was found to be a dihydro-derivative of roquefortine C, and to be identical with 1 of the 2 stereoisomers produced by reduction of roquefortine C with Zn in acetic acid, which hydrogenates the dehydrohistidine side chain. The structure of the dihydro-derivative is illustrated and the name roquefortine D is proposed for it. Its stereoisomer was not found in *P. roqueforti* cultures. DIH

82

Water-soluble products from patulin during alcoholic fermentation of apple juice.

Stinson, E. E.; Osman, S. F.; Bills, D. D.

Journal of Food Science 44 (3) 788-789 (1979) [En] [USDA E. Regional Res. Cent., SEA-AR, Philadelphia, Pennsylvania 19118, USA]

During the course of alcoholic fermentation, 50 p.p.m. of [^{14}C]patulin added to apple juice was converted to other materials. The products were largely nonvolatile and water soluble. Little, if any, patulin was metabolized to CO_2 . Comparison of the TLC migration of the major patulin products from fermentation with the products of the reaction of patulin with cysteine indicated that $\geq 58\%$ of the added patulin was converted to substances other than adducts of cysteine, peptides and proteins. In addition to a major TLC-immobile component (21%), ≥ 6 TLC-mobile patulin products were observed. IFT

83

[Mycotoxins and fruits.] [Review]

Dupaigne, P.

Fruits 33 (7/8) 505-519 (1978) [178 ref. Fr] [IRFA, BP 5035, 34032 Montpellier Cedex, France]

This article reviews the published work on mycotoxins in fruit, with special sections devoted to aflatoxins and patulin. The main mycotoxins, their fungal origin and toxic effects are tabulated. A survey of the occurrence of patulin on fruit and fruit products revealed no health hazard, as the amounts likely to be consumed are negligible. RM

84

Patulin in CA-stored apples. (In 'Controlled atmospheres for the storage and transport of perishable agricultural commodities' [see FSTA (1979) 11 8J1407])

[Lecture]

Sommer, N. F.; Buchanan, J. R.; Fortlage, R. J. pp. 212-221 (1977) [37 ref. En] [Dep. of Pomology, Univ. of California, Davis, California 95616, USA]

The significance of patulin is reviewed in relation to the blue-mould disease of apples caused by *Penicillium expansum*. It deals with the history and occurrence of patulin, accumulation in stored fruits, disappearance or detoxification of patulin, and patulin avoidance. AL

85

Thin layer chromatographic determination of citrinin.

Stubblefield, R. D.

Journal of the Association of Official Analytical Chemists 62 (1) 201-202 (1979) [10 ref. En] [USDA, Sci. & Education Administration, Regional Res. Cent., Peoria, Illinois 61604, USA]

Clearly defined zones of citrinin [isolated from cereals] can be obtained on TLC plates and measured by fluorodensitometry. Silica gel plates were prepared as a slurry with aqueous 0.05M disodium EDTA, spread at 0.5 mm wet thickness, and activated at 105°C for 1 h. Plates were developed in acetic acid/benzene (5 + 95). The limit of detection was 10 ng citrinin/zone.

Densitometric analysis (365 nm excitation, 505 nm emission) revealed that a linear relationship exists for levels of 10 ng to at least 100 ng/zone with a coeff. of variation of $\pm 5\%$. AS

86

Quantitation of zearalenone by gas-liquid chromatography on capillary glass columns.

Thouvenot, D. R.; Morfin, R. F.

Journal of Chromatography 170 (1) 165-173 (1979) [22 ref. En] [Lab. de Biochimie, Fac. des Sci., 29283 Brest, France]

A procedure is described for the quantitation of zearalenone from corn by GLC. An internal standard, zearalanone, is first mixed with the finely ground corn, followed by extraction with ethyl acetate, purification by TLC and formation of trimethyl silyl ether (TMS) and methyl oxime (MOX) derivatives. Positive identification of zearalenone is based upon the retention times of the TMS and MOX-TMS derivatives being identical with those of the standards, comparison of chromatograms from both derivatives and characteristic twin peaks of zearalenone MOX-TMS. The detection limit of 100 parts zearalenone/10⁹ in corn could only be improved by modification of the described procedure. AS

87

Toxicity of penicillium spp. from mould-ripened cheese.

Lück, H.; Wehner, F. C.; Steyn, M.

South African Journal of Dairy Technology 10 (4) 191-192 (1978) [8 ref. En, af] [Anim. & Dairy Sci. Inst., Irene, Transvaal, South Africa]

7 isolates of *Penicillium roqueforti* and 4 of *P. camemberti*, isolated from Roquefort, Camembert and Brie cheeses available in South Africa, were tested for mycotoxins. When cultured on maize, all the isolates of *P. roqueforti* were toxic to ducklings, though a considerable degree of variation in toxicity was evident. The toxicity of the isolates of *P. camemberti* was less pronounced than that of *P. roqueforti*. AS

88

[Contamination of spices and its effects in the food industry.]

Moreau, C.; Moreau, M.

Alimentation et la Vie 66 (3) 174-182 (1978) [19 ref. Fr]

See FSTA (1979) 11 1T39.

89

Spectrodensitometric determination of trichothecene mycotoxins with 4-(p-nitrobenzyl)pyridine on silica gel thin-layer chromatograms.

Takitani, S.; Asabe, Y.; Kato, T.; Suzuki, M.; Ueno, Y. *Journal of Chromatography* 172, 335-342 (1979) [15 ref. En] [Fac. of Pharmaceutical Sci., Sci. Univ. of Tokyo, Shinjuku-ku, Tokyo 162, Japan]

A simple method for detection and spectrodensitometric detn. of a number of trichothecene mycotoxins on silica gel layers based on a colour reaction between 4-(p-nitrobenzyl)pyridine and the 12,13-epoxy group in the trichothecene nucleus is described. Detection limits for the 12 trichothecenes examined were 0.025-0.2 µg/spot. 6 of the 12 trichothecenes could also be determined spectrodensitometrically in the range from about 0.05-0.2 to 10 µg/spot with a coeff. of variation of about 5%. Direct application of the method to trichothecenes in agricultural samples was unsuccessful because of interfering substances and further studies of clean-up procedures are required. The clean-up procedure of Naoi et al. [see FSTA (1976) 8 9C444] effectively recovered fusarenon-X added to a sample of polished rice, but not added T-2 toxin. AL

90

[Update on mycotoxin analysis.] [Conference proceedings]

Italy, Associazione Italiana Analisti Chimici *Tecnica Molitoria* 30 (2) 105-127 (1979) [many ref. It]

Papers are published that were presented at a meeting held at Bologna, Italy, 24-25 Nov. 1978, including some introductory remarks by G. Martini (pp 105-106); and Basic principles of mycology and mycotoxicology, by G. Cirilli (pp 107-109). A further 5 papers are abstracted individually and are listed in the FSTA author index under Italy, Associazione Italiana Analisti Chimici [Mycotoxin Symposium]. DIH

91

Significance of mycotoxins to food safety and human health. [Review]

Bullerman, L. B.

Journal of Food Protection 42 (1) 65-86 (1979) [189 ref. En] [Dep. of Food Sci. & Tech., Univ. of

Nebraska, Lincoln, Nebraska 68583, USA]

The significance of mycotoxins in food safety is considered under the headings of Mycotoxins, including aflatoxins, sterigmatocystin, ochratoxins, patulin, penicillic acid, zearalenone and T-2 toxin (chemical, physical and toxicological properties are tabulated); Relation to human health, including acute toxicity, carcinogenicity and chronic toxicity, and effect of diet and nutrition; Implications to food safety, including nuts and oilseeds, grains, fruits and vegetables, animal products; refrigerated foods, stability of mycotoxins in foods, regulation and control mycotoxins; and Conclusions. DIH

92

Mycotoxins in foodstuffs. [Conference proceedings] International Union of Pure & Applied Chemistry *Archives de l'Institut Pasteur de Tunis* 54 (3/4) 230-535 (1977) [many ref. En, Fr]

The full text is given of papers on analysis, control and detoxification of mycotoxins, presented at this symposium held in Paris, France, on 16-18 Sept. 1976, including the following: Identification of mycotoxins by species of *Fusarium* and *Stachybotrys* obtained from East Europe, by C. Szathmary, C. J. Mirocha & M. Palyusik (pp. 347-354, 8 ref., En, fr); Control of mycotoxins and moulds in Sweden, by G. Nilsson (pp. 391-393, 1 ref., En); Genetically determined structural parameters of the seed coat affecting the colonization of peanut seeds by aflatoxin producing *aspergilli*, by M. C. Dieckert & J. W. Dieckert (pp. 441-459, 17 ref., En, fr); and Reduction of mycotoxin contamination in peanuts through resistant variety development, by R. E. Pettit, R. A. Taber, O. D. Smith & B. L. Jones (pp. 501-510, 9 ref., En). A further 21 papers are abstracted separately in FSTA, and are listed in the author index under International Union of Pure & Applied Chemistry [Mycotoxins Symposium]. [See also FSTA (1978) 10 9C297 for further sections of this symposium.] AJDW

93

[Mycotoxicological analysis of foods.]

Fremy, J.-M.; Corbion, B.

Annales des Falsifications et de l'Expertise Chimique 72 (772) 53-64 (1979) [16 ref. Fr, en] [Min. de l'Agric., Services Vet. Lab. Cent. d'Hygiene Alimentaire, 43 Rue de Dantzig 75015, Paris, France]

A brief review is given of methods for detection and detn. of mycotoxins, chiefly in animal feed, but also in food, for the following: aflatoxin B₁, aflatoxin M₁, zearalenone, patulin, ochratoxin A and sterigmatocystin. Limits of detection of the referenced methods are tabulated. DIH

94

[Mycotoxins.] [Review]

Kravchenko, L. V.; Tutel'yan, V. A.

Zhurnal Vsesoyuznogo Khimicheskogo Obshchestva im. D. I. Mendeleeva 23 (4) 390-404 (1978) [198 ref. Ru] [Inst. Pitaniya AMN SSSR, USSR]

Data on mycotoxins, the highly toxic metabolites of some moulds which attack foods and fodder, are

reviewed. Problems related to propagation of mycotoxins in nature, their toxic and carcinogenic properties and the mechanism of their action are discussed. Special attention is given to the aflatoxins group, which have marked hepatotoxic and hepatocarcinogenic properties, ochratoxins, citrinin, patulin, trichothecenes, sporofurazariogenin and several other mycotoxins associated with food-borne mycotoxicosis. STI

95

Preliminary report on toxigenic fungal isolates of *Aspergillus niger* in market foods and foodstuffs.

Glinsukon, T.; Romruen, K.; Visutasunthorn, C.

Experientia 35 (4) 522-523 (1979) [14 ref. En] [Dep. of Physiol., Fac. of Sci., Mahidol Univ., Bangkok, Thailand]

22 isolates of *Aspergillus niger* were obtained from market foods in Bangkok. The isolates were grown on mouldy rice, and the toxicity of extracts from the cultures to weanling rats was studied. 14 of the 22 isolates were moderately to highly toxic (food sources included rice, mung bean, corn, roast peanut and soybean). Results suggested that most of the effects were due to nephrotoxins. 2 of the cultures produced small amounts of aflatoxin B₁ (12 and 34 µg/kg mouldy rice). DIH

96

Moniliformin, a metabolite of *Fusarium moniliforme* NRRL 6322: purification and toxicity.

Burmeister, H. R.; Ciegler, A.; Vesonder, R. F.

Applied and Environmental Microbiology 37 (1) 11-13 (1979) [20 ref. En] [Agric. Res., Sci. & Education Administration, USDA, Peoria, Illinois 61604, USA]

Because of the toxicity of moniliformin to chickens, its phytotoxicity, the prevalence of the producing fungus on grain, and detection, production and purification of moniliformin from corn grits are reported; its toxicity to chicks and mice was studied. AL

97

α-amanitin: inactivation by bovine lactoperoxidase.

Morris, P. W.; Kelley, K. M.; Logas, W. G.

Experientia 35 (5) 589-591 (1979) [23 ref. En] [Dep. of Biol. Chem., Univ. of Illinois Med. Cent., Chicago, Illinois 60612, USA]

Amatoxins are not restricted to *Amanita* but also occur at nontoxic levels in several edible mushrooms. The principal amatoxin, α-amanitin, was found to be extremely sensitive toward lactoperoxidase catalysed degradation, rather than iodination, of the indole nucleus. Extensive attenuation of inhibitor potency against eukaryotic DNA-dependent RNA polymerase II accompanied the treatment of α-amanitin with lactoperoxidase, iodide and H₂O₂. AS

98

T-2 toxin mycotoxicosis in the guinea-pig.

DeNicola, D. B.; Rebar, A. H.; Carlton, W. W.; Yagen, B.

Food and Cosmetics Toxicology 16 (6) 601-609 (1978) [9 ref. En] [Dep. of Vet. Microbiol. & Path., School of

Vet. Med., Purdue Univ., W. Lafayette, Indiana 47907, USA]

The trichothecene mycotoxin, T-2 toxin, has been consistently isolated from several spp. of *Fusarium*. The present study defines the pathology of T-2 toxin mycotoxicosis in the guinea pig. VJG

99

Moulds, toxins and food. [Book]

Moreau, C.; Moss, M.

x + 477pp. ISBN 0-471-99681-5 (1979) [many ref. En] Chichester, W. Sussex, UK; John Wiley & Sons Ltd. Price £21.00

This En translation of the original Fr edition of this textbook [see FSTA (1977) 9 2C80] includes the following sections: Food-borne moulds (pp. 3-26); Mycotoxicoses and mycotoxins (pp. 27-62); Aflatoxicosis (pp. 63-143); Clavacitoxicosis (pp. 144-157); Other aspergillotoxicoses (pp. 158-189); Islanditoxicosis (pp. 190-196); Diverse *Penicillium* toxicoses (pp. 197-216); Fusariotoxicoses (pp. 217-236); Sporidesmiotoxicosis (pp. 237-244); Stachybotryotoxicosis (pp. 245-251); Other mycotoxicoses (pp. 252-272); Perspectives of the struggle (pp. 273-285); and Recent developments in the study of mycotoxins (pp. 286-319). An extensive bibliography (pp. 320-458) is given, together with a 7-pp. taxonomic index and an 11-pp. subject index. AJDW

100

[Importance and analysis of mycotoxins other than aflatoxin.] Bedeutung und Analytik von Mykotoxinen ausser Aflatoxin.

Müller, H.-M.

Landwirtschaftliche Forschung Sonderheft 33/1, 282-297 (1977) [124 ref. De, en, fr] [Univ. Hohenheim, Postfach 106, D-7000 Stuttgart 70, Federal Republic of Germany]

The chemical structure, biological properties, natural occurrence, fungal origin and methods for detn. of the following mycotoxins are described: zearalenone, 12,13-epoxytrichothecenes (T-2 toxin, diacetoxyscirpenol), ochratoxin A, citrinin, sterigmatocystin and penicillic acid. AS

101

[Chemical and biological aspects of mycotoxins.]

[Lecture]

Battaglia, A.

Tecnica Molitoria 30 (2) 110-114 (1979) [It]

Brief discussions are given of aflatoxins, sterigmatocystin, ochratoxin, zearalenone, trichothecenes, tremorgens and patulin; aspects considered include structure, toxicity, stability, UV-fluorescence characteristics, microorganisms forming these toxins, and foods in which they occur. [See FSTA (1979) 11 9C476.] AJDW

102

[Method for determination of mycotoxins.] [Lecture]

Cirilli, G.; Cantafora, A.; Bonora, S.; Angeli, A. degli

Tecnica Molitoria 30 (2) 125-126 (1979) [It]

A 50 g sample of the food under test is mixed with

10 g Celite, and extracted with acetone/water (80:20); the acetone is eliminated from the extract by evaporation, and the aqueous residue is defatted with hexane or isooctane in a separating funnel. The aqueous phase is then extracted 3 x with chloroform. The chloroform extract is concentrated to 50 ml, mixed with 60 ml hexane, and separated by column chromatography on silica gel, aflatoxins and trichothecenes being eluted with methanol/chloroform (7:93), ochratoxins and patulin being eluted with benzene/acetic acid (90:10), or all mycotoxins being eluted with toluene/acetic acid/formic acid (50:40:10). The eluates are evaporated to dryness, and the residues dissolved in chloroform. The mycotoxins are then separated by TLC on silica gel, using a toluene/acetic acid/formic acid (60:32:8) solvent system. Mycotoxins may be identified and determined by UV fluorescence measurement. [See FSTA (1979) 11 9C476.] AJDW

103

The direct thin layer chromatographic densitometric identification of eight mycotoxins. [Lecture]

Reimerdes, E. H.

Archives de l'Institut Pasteur de Tunis 54 (3/4) 335-345 (1977) [14 ref. En, fr] [Inst. für Chem., Bundesanstalt für Milchwissenschaft, D-2300 Kiel, Federal Republic of Germany]

A TLC procedure for separation and identification of the mycotoxins (i) citrinin, (ii) patulin, (iii) penicillic acid, (iv) aflatoxin B₁, (v) aflatoxin B₂, (vi) sterigmatocystin, (vii) ochratoxin and (viii) citreoviridin is described. The mycotoxins are separated on plates coated with Schleicher & Schüll G 1500 silica gel and developed with the following solvent systems: (iv) and (v), chloroform/acetone/n-hexane (85:15:20); (i), (ii), (vi) and (vii), toluene/ethyl acetate/90% formic acid (10:3:1); (iii) toluene/ethyl acetate/90% formic acid (6:3:1); and (viii) acetone/n-hexane (1:1). A mixture of (i), (iii) and (vii) could be separated using benzene/methanol/acetic acid (24:2:1). The mycotoxin flecks are identified by direct spectral densitometry on the TLC plates. UV/visible spectra of (i)-(viii) are presented. The method is applicable to relatively impure extracts. Good results were achieved; identification of mycotoxins at levels in the ng range is possible. [See FSTA (1979) 11 9C478.] AJDW

104

Occurrence and prevention of mycotoxins in pecans. [Lecture]

Schroeder, H. W.

Archives de l'Institut Pasteur de Tunis 54 (3/4) 479-485 (1977) [4 ref. En, fr] [USDA, PO Box ED, College Station, Texas 77840, USA]

Contamination of pecans with toxigenic fungi and mycotoxins is discussed, on the basis of literature and experimental data. No mycotoxins were detected in pecans from orchards of the Agricultural Research Service or the Texas Agricultural Experiment Station. Aflatoxins were detected at a level of 36 parts/billion (p.p.b.) in a single sample of pecans from a retail outlet. Studies on pecan 'pickouts' (damaged and discoloured kernels) from commercial shellers showed aflatoxin concn. ≤ 50 p.p.b.; the average concn. was, however, only 5 p.p.b. Other mycotoxins (alternariol, alternariol

monomethyl ether, sterigmatocystin, and zearalenone) were also detected in pecans. Both *Aspergillus flavus* and *Asp. parasiticus* were capable of invasion of, and aflatoxin formation in, undamaged pecans; cracked pecans or thin-shelled pecan var. were more susceptible to mould invasion and aflatoxin formation than sound nuts of thick-shelled var. Nuts which had lain on the ground for ≥ 1 wk had a high incidence of mould contamination. Mechanical harvesting may cause a relatively high incidence of cracking of the shells; efficient cleaning, drying and storage are therefore essential if mould growth is to be avoided. [See FSTA (1979) 11 9C478.] AJDW

105

Analysis of patulin in apple beverages sold in Sweden. [Lecture]

Josefsson, E.; Andersson, A.

Archives de l'Institut Pasteur de Tunis 54 (3/4) 261-267 (1977) [9 ref. En] [Nat. Food Administration, Box 622, S-751 26 Uppsala, Sweden]

A GLC procedure for detn. of patulin is described, based on separation of the trimethylsilyl ether derivative, using a column comprising 10% DC-200 and 15% QF-1, each on Chromosorb W AW DCMS (100-120 mesh), in a 1:1 mixture. An electron capture detector is used. Patulin may be confirmed by MS or TLC. Recovery is 86-104% for patulin concn. $> 5 \mu\text{g/l}$. Studies on 66 commercial apple juices showed that 37 had patulin concn. $\leq 5 \mu\text{g/l}$; of the remaining samples, 13 had patulin concn of 5-15 $\mu\text{g/l}$, 7 had levels of 15-25 $\mu\text{g/l}$, 7 had levels of 25-35 $\mu\text{g/l}$, 1 had a level of 35-45 $\mu\text{g/l}$, and 1 had a level of 54 $\mu\text{g/l}$. Although these levels are relatively low compared to those recorded in other countries, the desirability of minimization of patulin levels is stressed. [See FSTA (1979) 11 9C478.] AJDW

106

[Determination of zearalenone in maize and in animal feeds by 2-dimensional TLC.] [Lecture]

Jemmali, M.

Archives de l'Institut Pasteur de Tunis 54 (3/4) 249-256 (1977) [7 ref. Fr, en] [INSERM, Service Mycotoxins, INRA, 16 Rue Nicolas Fortin, 75013 Paris, France]

An acetonitrile extract of the sample under test is purified by extraction of interfering substances with isooctane, and treatment with lead acetate and Celite 585; zearalenone is then extracted into chloroform, the extract evaporated to dryness, and the dry residue taken up in a benzene/acetonitrile (98:2 v/v) mixture. The resulting solution is then analysed by 2-dimensional TLC, using toluene/ethyl acetate/formic acid (6:3:1, v/v) and chloroform/ethanol (95:5, v/v) solvent systems. Zearalenone may be determined by fluorodensitometry of the appropriate flecks on the chromatogram (excitation at 313 nm, emission at 443 nm). The identity of zearalenone may be confirmed by spraying the chromatogram with 50% methanolic H_2SO_4 , followed by heating at 100°C for 10 min; UV fluorescence of zearalenone changes from blue to yellow. Recovery is high (94.4%), and reproducibility is good. Detection limit is approx. 50 parts/billion. [See FSTA (1979) 11 9C478.] AJDW

107

Thin layer analysis of Fusarium toxins in grain samples. [Lecture]

Niku-Paavola, M.-L.; Ilus, T.; Ward, P. J.; Nummi, M. *Archives de l'Institut Pasteur de Tunis* 54 (3/4) 269-277 (1977) [10 ref. En, fr] [Tech. Res. Cent. of Finland, Biotech. Lab., Box 192, SF-00121 Helsinki 12, Finland]

A procedure for detn. of *Fusarium* spp. toxins in grain is described, based on extraction of a ground grain sample with ethyl acetate in the presence of diatomaceous earth, filtration, evaporation of the extract, partition between n-hexane and methanol/water (4:1), dilution of the methanol/water phase and re-extraction of toxins into ethyl acetate/chloroform (1:1). After conc. by evaporation, the extract is purified on a column containing 10 g silica gel 60 (elution with ethanol/chloroform 6:94). Toxins are then separated on a second silica gel column, F2 toxin being eluted with 120 ml n-hexane/acetone (6:1) followed by 20 ml n-hexane/acetone (3:1). T2 toxin is then eluted with 120 ml n-hexane/acetone (3:1); and HT2 + neosolaniol are eluted with 10 ml n-hexane/acetone (3:1) followed by 120 ml n-hexane/acetone (1:1). The toxins may be further purified on a 3rd column. The eluates are evaporated to dryness, dissolved in chloroform, and analysed by TLC on silica gel 60F254. An ethanol/chloroform solvent system (3:97) is used for T2 and F2, and an ethanol/chloroform (7:93) solvent system for HT2 and neosolaniol. F2 is visualized by spraying with Al_2Cl_3 reagent; the other 3 toxins are visualized with p-anisaldehyde reagent. If necessary, 2-dimensional TLC may be used, with petroleum ether/ethyl acetate (3:1) and toluene/acetone (9:1) for F2, petroleum ether/acetone (7:2) and chloroform/ethanol (97.5:2.5) for T2, and chloroform/ethanol (94:6) and petroleum ether/acetone (3:2) for HT2 and neosolaniol. Detection limits were 0.2 mg/kg for F2, and 0.6 mg/kg for the other toxins. [See FSTA (1979) 11 9C478.] AJDW

108

Analytical problems and method modifications in mycotoxin determination in cereals and feeds. [Lecture]

Piskorska-Pliszczynska, J.; Juskiewicz, T.

Archives de l'Institut Pasteur de Tunis 54 (3/4) 279-288 (1977) [10 ref. En] [Dep. of Pharmacology & Toxicology, Vet. Res. Inst., 24-100 Pulawy, Poland]

A procedure for detn. of mycotoxins in cereals is described, based on extraction with acetonitrile/4% aqueous KCl solution (9:1), purification of the extract by partition against isooctane, re-extraction of mycotoxins from the acetonitrile phase into chloroform, evaporation of the chloroform extract to dryness, dissolving the residue in benzene/acetonitrile, and TLC analysis on silica gel H plates. For detn. of aflatoxins, the chromatograms are developed with chloroform/trichlorethylene/ethyl alcohol/formic acid (80:15:4:1); for detn. of ochratoxins, sterigmatocystin and zearalenone, the chromatograms are developed with toluene/ethyl acetate/formic acid (60:30:10). Flecks may be tentatively evaluated under UV light; methods for chemical confirmation are specified. Quantitative detn. may be performed by densitometry on the

developed plates. Detection limits were: aflatoxins 5 µg/kg, ochratoxins 100 µg/kg, sterigmatocystin 50 µg/kg and zearalenone 400–500 µg/kg. [See FSTA (1979) 11 9C478.] AJDW

109

[Application of high performance liquid chromatography to determination of aflatoxins and other mycotoxins in oilseed presscakes and derived products.] [Lecture]

Blanc, M.; Midler, O.; Karleskind, A.

Archives de l'Institut Pasteur de Tunis 54 (3/4) 305–324 (1977) [14 ref. Fr] [Lab. Wolff, 198 Rue Sigmund Freud, 75019, Paris, France]

A procedure is described for detn. of mycotoxins in oilseed presscake etc. Chloroform extracts are analysed, without further purification, by high-performance liquid chromatography on a 15 cm Lichrosorb Si 60 column using an isooctane/isopropyl ether/methylene chloride/ethyl acetate/acetonitrile (35:40:15:5:5) mobile phase, with UV spectrophotometric detection. Detector response is linear over a wide range of mycotoxin concn., e.g. 1–1000 ng aflatoxin B₁. Repeatability is good. Detection limit is 1 ng for aflatoxin B₁. Practical application of this technique to analysis of oilseed presscakes etc. is described. [See FSTA (1979) 11 9C478.] AJDW

110

Configuration of the 3,12 double bond of roquefortine.

Scott, P. M.; Polonsky, J.; Merrien, M.-A.

Journal of Agricultural and Food Chemistry 27 (1) 201–202 (1979) [18 ref. En] [Food Directorate, Health Protection Branch, Ottawa, Ontario, K1A 0L2 Canada]

The E configuration of the 3,12 double bond of roquefortine, a metabolite of the commercially important fungus *Penicillium roqueforti* (and found in Blue cheese), was established by comparison of its spectral properties with those of a photoisomer. The structure (E)-3-(1H-imidazol-4-ylmethylene)-6-(1H-indol-3-ylmethyl)-2,5-piperazinedione is proposed for the major product of an acid-catalysed desiprenylation reaction of roquefortine. AS

111

Prevention of toxin mold growth in cheese by pimarin. [Lecture]

Shahani, K. M.; Bullerman, L. B.; Evans, T. A.; Arnold, R. G.

Archives de l'Institut Pasteur de Tunis 54 (3/4) 511–520 (1977) [10 ref. En]

Studies were made of the inhibitory effect of pimarin upon *Aspergillus parasiticus*, capable of producing aflatoxin, and *Penicillium patulum*, capable of producing patulin, in Cottage, Cheddar and Parmesan cheese. Pimarin added at 0.5–5.0 p.p.m. to Cottage cheese delayed the sporulation of the 2 moulds and inhibited their growth rate. With Cheddar cheese, dipping the cheese blocks in 1000 or 2000 p.p.m. pimarin suspension retarded the mould growth. Adding 500–1000 p.p.m. pimarin in the plastics coat applied to Parmesan cheese provided added inhibitory

effect upon the mould on the cheese. The moulds produced no detectable toxins. [See FSTA (1979) 11 9C478.] JMD

112

A fluorospectrophotometric method for ochratoxin analysis and the spontaneous occurrence of ochratoxin in pig kidneys in Sweden. [Lecture]

Gatenbeck, S.; Hult, K.; Rutqvist, L.

Archives de l'Institut Pasteur de Tunis 54 (3/4) 257–260 (1977) [3 ref. En] [Royal Inst. of Tech., S-100 44 Stockholm 70, Sweden]

A procedure for detn. of ochratoxin A in extracts from foods etc. is described; it is based on the difference in excitation max. between ochratoxin A (380 nm) and its proteolytic cleavage product ochratoxin α (340 nm). Excitation spectra are recorded both before and after incubation of the extract with carboxypeptidase A; the ochratoxin A concn. in the original sample may thus be calculated on the basis of loss of fluorescence at 380 nm. Recovery of ochratoxin A from artificially contaminated kidney samples was 85% immediately after contamination, vs. 80% and 65% after storage at –70°C for 19 and 54 days resp. Studies, using this technique, on kidney samples from 129 swine from 4 Swedish slaughterhouses are briefly described; the kidneys examined were abnormal in colour, consistency or size. Ochratoxin A residues were detected in kidneys of 32 swine (29% of the total). The highest ochratoxin A levels (≤ 104 parts/billion) were observed in kidneys showing fibrous interstitial nephritis, a condition corresponding well with renal lesions induced by ochratoxin A-containing feed. [See FSTA (1979) 11 9C478.] AJDW

113

Semiquantitative determination of the mycotoxin sterigmatocystin on thin-layer chromatograms with a grey scale.

Reiss, J.

Zeitschrift für Analytische Chemie 275 (1) 30 (1975) [3 ref. En] [Mikrobiol. Lab. der Grahamhaus Studt KG, D-6550 Bad Kreuznach, Federal Republic of Germany]

A fast procedure for semiquantitative detn. of sterigmatocystin (an occasional food contaminant) was developed. A chloroform solution of the toxin is spotted onto a silica gel-coated sheet, which is developed with toluene/ethyl acetate/90% formic acid (5:4:1), sprayed with 20% AlCl₃, and the dried chromatogram examined under UV light at 365 nm; the intensity of fluorescence is estimated by covering the fluorescing spot by a grey scale commonly used in photographic laboratories. Limit of detection is 0.01 µg; estimation is more accurate between 0.02 and 1.00 µg. A standard curve for disappearance of the fluorescence is shown. RM

114

Semiquantitative estimation of the mycotoxins citrinin, ochratoxin A, aflatoxin M, and penicillic acid on thin-layer chromatograms with a grey scale.

Reiss, J.

Zeitschrift für Analytische Chemie 293 (2) 138–140 (1978) [6 ref. En, de] [Mikrobiol. Lab. der Grahamhaus Studt KG, D-6550 Bad Kreuznach, Federal Republic of Germany]

Germany]

The semiquantitative method previously developed for detn. of aflatoxins B₁ and G₁, [FSTA (1974) 6 2C50] and for sterigmatocystin [see preceding abstr.] in bread and bakery goods was adapted for detn. of citrinin, ochratoxin A, aflatoxin M₁, and penicillic acid. Silica gel chromatograms of the mycotoxins, visualized at 365 nm, were estimated using a Kodak grey scale commonly used in photographic laboratories. Limits of detection were 0.01, 0.006, 0.002 and 0.01 µg, resp. Standard curves for disappearance of fluorescence are reproduced for the 4 mycotoxins. RM

115

[Determination and hygienic-toxicological significance of patulin in fruit and fruit products.] Zur Analytik und lebensmittelhygienisch-toxikologischen Bedeutung von Patulin in Obst und Obstprodukten. Fritz, W.; Buthig, C.; Engst, R. *Nahrung* 23 (2) 159-161 (1979) [41 ref. De, en, ru] [Zentralinst. für Ernährung, Potsdam-Rehbrücke, German Democratic Republic]

The combination of extraction, chromatography and fluorescence densitometry permits detn. of patulin in fruits and fruit products with great precision and sensitivity. The limit of detection is 10 µg/kg; recovery rates range from 86 to 92%, with a variation coeff. between 5.6 and 13.6%. Interference due to patulin-simulating substances is largely excluded. Patulin concn. ranging from 0.3 to 42 mg/kg were found in the brown-rotten portions of apples. Juices domestically prepared from healthy fruits and fruits free from rotten portions contained no patulin. Patulin concn. ranging from 0.02 to 0.3 mg/l. were observed in commercial apple juices. Patulin values ≤ 50 mg/l. were found in mouldy apple juices and ≤ 0.4 mg/kg in mouldy peach preserves. Patulin was not detectable in cereals which had gone mouldy spontaneously, in bread samples, in commercial fruit or vegetable juices (other than apple), or in cider. The fruits and fruit products were analysed not only for patulin, but also for aflatoxin and ochratoxin; the latter 2 toxins were not found in any of the samples examined. The possibilities of manufacturing patulin-free products are discussed. IN

116

A synergistic effect on nitrosodimethylamine on sterigmatocystin carcinogenesis in rats.

Terao, K.; Aikawa, T.; Kera, K.

Food and Cosmetics Toxicology 16 (6) 591-596 (1978) [21 ref. En] [Res. Inst. for Chemobiodynamics, Chiba Univ., 280 Chiba, Inohana 1-8-1, Japan]

Sterigmatocystin, a compound related to aflatoxin B₁, is a metabolite of *Aspergillus versicolor*, *A. nidulans* and *Bipolaris* spp. and is known to be a food contaminant in certain temperate and tropical zones. The possible syncarcinogenic effects of (i) nitrosodimethylamine and (ii) sterigmatocystin in rats were investigated by feeding rats diets containing the following: 10 p.p.m. (ii); 10 p.p.m. (ii) + 1 p.p.m. (i); 1 p.p.m. (ii) + 10 p.p.m. (i); or 10 p.p.m. (i) for 54 wk. It was found that (i) alone did not induce hepatic carcinomas, but it may have a role in (ii)-carcinogenesis in the liver, as an inducer of carcinogen-activating enzymes. VJG

117

Mycotoxin separation on thin layer of corn starch. Miskovic, D.; Perisic-Janjic, N.

Chromatographia 12 (1) 33-35 (1979) [18 ref. En] [Inst. of Chem., Univ. of Novi Sad, Veljka Vlahovica 2, 21000 Novi Sad, Yugoslavia]

12 mycotoxins (aflatoxins B₁, B₂, G₁, G₂, M₁, M₂, zearalenone, zearalenol, ochratoxins A, B, B ester and C) were separated by TLC on native corn starch using the following solvent systems: (i) benzene; (ii) toluene, (iii) xylene, (iv) benzene/toluene/cyclohexane/ethanol (absolute) at 3:3:5:0.1, or (v) cyclohexane/benzene/glacial acetic acid at 5:3:0.2, with detection by UV fluorescence at 254-366 nm. Tabulated R_f values showed that best separation was obtained by solvent systems (iii) and (iv); strongest fluorescence was by systems (i), (ii) and (iii). Lower limits of visual detection were: aflatoxins B₁, B₂, G₁ and G₂ 10⁻³ ng; M₁ and M₂ 10⁻² ng; ochratoxins A, B and B ester, and C 10⁻¹ ng; and zearalenone and zearalenol 10⁰ ng. RM

118

Ochratoxin A and citrinin in 1976 crop of barley stored on farms in Sweden.

Hökby, E.; Hult, K.; Gatenbeck, S.; Rutqvist, L.

Acta Agriculturae Scandinavica 29 (2) 174-178 (1978) [12 ref. En] [Dep. of Biochem. & Biotech., Royal Inst. of Tech., S-100 44 Stockholm, Sweden]

Studies were conducted in 1977 on 26 farms in 10 different regions of Sweden, to determine the incidence of the mycotoxins ochratoxin A and citrinin in stored barley. 169 samples of barley of various var. and initial moisture contents, were collected 2 wk before harvest, at harvest, and after storage for ≤ 9 months. Tables of data are given showing the incidence of infestation with *Penicillium* and *Aspergillus* spp., and contamination with mycotoxins. Overall, 17 samples contained ochratoxin A (at concn. ≤ 20 parts/billion); 4 contained citrinin (at concn. ≤ 480 parts/billion). The relation between aflatoxin formation and the variables studied is briefly considered; the incidence of mycotoxins was, however, too low for clear conclusions to be drawn. AJDW

119

Transmission of T-2 toxin into bovine and porcine milk.

Robison, T. S.; Mirocha, C. J.; Kurtz, H. J.; Behrens, J. C.; Chi, M. S.; Weaver, G. A.; Nystrom, S. D.

Journal of Dairy Science 62 (4) 637-641 (1979) [14 ref. En] [Dep. of Plant Path., Univ. of Minnesota, St. Paul, Minnesota 55108, USA]

A pregnant Holstein cow (3rd trimester) was intubated with 182 mg of T-2 for 15 consecutive days. This amount of toxin corresponds to a concn. in the feed of 50 p.p.m. (from consumption of 3.6 kg grain-type ration/day). Milk samples (approx. 1 l.) were taken on the 2nd, 4th, 5th, 8th, 10th and 12th day of T-2 intubation and were analysed specifically for T-2 toxin by combined gas chromatography-MS. All samples except those collected on the 4th and 8th days of intubation contained T-2 toxin in concn. ranging from 10 to

160 parts/billion (p.p.b.) (10–160 ng/g milk). The min. T-2 concn. detectable by the spectrometry in the selected ion monitoring mode and the extraction procedures described, lies between 5 and 10 p.p.b. for cow's milk. The amounts of T-2 administered and the duration of exposure of this animal to the toxin were unusually high and, therefore, afforded detectable quantities in the milk. At concn. reportedly found in nature (2 p.p.m. in the feed or 1/25 of the amounts administered in this experiment) it would not be possible to detect the low levels of toxin which probably would be in the milk. AS

120

Isolation and purification of ochratoxin A.

Bungé, I.; Heller, K.; Röschenhaler, R.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 168 (6) 457–458 (1979) [6 ref. En, de] [Inst. of Microbiol., Univ. of Münster, Tibusstrasse 7–15, D-4400 Münster, Federal Republic of Germany]

A simple and cheap method was developed for production of ochratoxin A, required for further study because of its importance as a food contaminant produced at low and high temp. Inoculated wheat is incubated, in a horizontally rotating Erlenmeyer flask equipped with baffles, for 15–20 days at room temp. The kernels are then extracted with acid chloroform and the extract is purified with sequential Sephadex LH20 and silica gel column chromatography. Ochratoxin A was then crystallized from benzene in a yield of 200 mg/100 g wheat. DIH

121

Thin layer chromatographic determination of aflatoxins, ochratoxins, sterigmatocystin, zearalenone, citrinin, T-2 toxin, diacetoxyscirpenol, penicillic acid, patulin, and penitrem A.

Gimeno, A.

Journal of the Association of Official Analytical Chemists 62 (3) 579–585 (1979) [24 ref. En] [Piensos Compuestos Rosell S. A. (Picrosa), Laboratorio Control de Calidad, Francisco Moragas, 12, Manresa, Barcelona, Spain]

A general method is described for determining 16 mycotoxins in grains and meals for food and feed. Mycotoxins are extracted and cleaned up by extracting with solvents of different pH. TLC is used to separate the toxins (29 developing solvents for separation and subsequent confirmation are listed); toxins are then quantitated by the limit detection method. Min. detectable concn. (µg/kg) of mycotoxins in corn, barley, sorghum, oats, millet, rye, wheat, soybean meal, peanut products and sunflower meal are: aflatoxin B₁ or G₁, 4–5; ochratoxin A or ethyl ester A, 140–145; citrinin, 600–750; zearalenone, 410–500; sterigmatocystin, 140–145; diacetoxyscirpenol, 2400–2600; T-2 toxin, 800–950; patulin, 750–800; penitrem A, 14 000–14 500; and penicillic acid, 3400–3650. DIH

122

Simultaneous extraction and fractionation and thin layer chromatographic determination of 14 mycotoxins in grains.

Takeda, Y.; Isohata, E.; Amano, R.; Uchiyama, M. *Journal of the Association of Official Analytical Chemists* 62 (3) 573–578 (1979) [8 ref. En] [Nat. Inst. of Hygienic Sci., Div. of Food, 1-18-1 Kamiyoga Setagaya, Tokyo, Japan 158]

A simple, systematic analytical method for multiple mycotoxins was developed for detecting 14 mycotoxins: aflatoxins B₁, B₂, G₁, and G₂, sterigmatocystin, T-2 toxin, diacetoxyscirpenol, neosolaniol, fusarenon X, zearalenone, ochratoxin A, citrinin, luteoskyrin, and rugulosin. These mycotoxins were extracted with 20 % H₂SO₄/4% KCl/acetonitrile (2 + 20 + 178), defatted with isooctane, and transferred to chloroform. The chloroform extract was cleaned up by silica gel column chromatography; the first 10 toxins were eluted with chloroform/methanol (97 + 3) and the remaining 4 toxins with benzene/acetone/acetic acid (75 + 20 + 5). Each fraction was analysed by TLC for the final detn. The method was applied to polished rice, rough rice, corn, wheat, and peanuts as an analytical screening procedure. The detection limits in these commodities ranged from 10.0 to 800.0 µg/kg, depending on the mycotoxin, but all limits were superior to those obtained for the individual mycotoxins by using other methods. AS

123

Insecticide inhibition of growth and patulin production by *Penicillium urticae*.

Draughon, F. A.; Ayres, J. C.

Journal of Food Science 44 (4) 1232–1234 (1979) [14 ref. En] [Dep. of Food Sci., Univ. of Georgia, Athens, Georgia 30602, USA]

Experiments were undertaken to evaluate the effect of insecticides from selected chemical groups on growth and patulin production by *P. urticae* at concn. of 1, 10 and 100 mg insecticide/l. The organophosphate insecticides Naled and Dichlorvos inhibited patulin production by 100 and 89%, resp., at the 100 mg/l concn. Variable inhibitory activities were ascribed to the organophosphate insecticides malathion and Diazinon which inhibited patulin production by 0–52% at 100 mg/l. The carbamate insecticides Landrin and Sevin inhibited patulin production by 85 and 100% and completely inhibited sporulation at 100 mg/l.; however, they did not inhibit growth of *P. urticae* significantly. Inhibition of growth and sporulation by other insecticides varied and was not significant at 1 or 10 mg/l. IFT

124

Detoxification of oilseed material.

Snamprogetti Spa

British Patent 1 539 903 (1979) [En]

Process is described for the extraction of mycotoxins from oil seed flour under mild conditions which employs a polar organic solvent e.g. n-butyl alcohol containing an aqueous electrolyte (HCl). IFT

125

Screening methods for the detection of thirteen common mycotoxins.

Gorst-Allman, C. P.; Steyn, P. S.

Journal of Chromatography 175 (2) 325–331 (1979)

[20 ref. En][Nat. Chem. Res. Lab., PO Box 395, Pretoria 0001, South Africa]

A study of screening methods for 13 mycotoxins showed that they can be separated as neutral and acidic metabolites. R_f values were determined in several solvent systems. Reactions of the mycotoxins with well known spray reagents were investigated, and their detection limits were established. A general procedure for extraction of mycotoxins from contaminated samples is described; it was tested with sterilized maize samples contaminated with *Aspergillus flavus*, *A. versicolor* and *Penicillium cyclopium*. AS

126

[Hygienic significance of patulin in foods.

I. Analytical detection of patulin.] Zur hygienischen Bedeutung von Patulin in Lebensmitteln. 1. Zum analytischen Nachweis von Patulin.

Koch, C. E.; Thurm, V.; Paul, P.

Nahrung 23 (2) 125-130 (1979) [20 ref. De, en, ru] [Bezirks-Hygiene-Inspektion & -Inst., Leipzig, German Democratic Republic]

A TLC method for routine detn. of patulin in fruit and vegetable products is described. The samples are extracted with ethyl acetate, and the extracts are purified on a Florisil column. Separation is performed by means of a one-dimensional technique, using toluene/ethyl acetate/formic acid (5 + 4 + 1), or, in the presence of interfering contaminants by means of a two-dimensional technique, using benzene/methanol/glacial acetic acid (90 + 5 + 5) for the first run, and toluene/ethyl acetate/formic acid (5 + 4 + 1) for the second run. Patulin is detected by spraying with a benzidine solution, after chlorination. The limits of detection are 5 µg/l. of juice and 5 µg/kg of fruit or vegetable. Derivatization with acetic anhydride/pyridine is used for corroborating the results obtained. The significance of 5-hydroxymethylfurfural as an interfering substance in apple juices is discussed. IN

127

[Hygienic significance of patulin in foods.

II. Occurrence of patulin in fruit and vegetables.] Zur hygienischen Bedeutung von Patulin in Lebensmitteln. 2. Zum Vorkommen von Patulin in Obst und Gemüse. Thurm, V.; Paul, P.; Koch, C. E.

Nahrung 23 (2) 131-134 (1979) [14 ref. De, en, ru] [Inst. für Exp. Epidemiologie, Wernigerode, German Democratic Republic]

Analyses of > 200 samples of various foods of plant origin showed that patulin was present in 36% of the fresh and canned fruits and in 7% of the vegetables infested with mould. Pears, plums, peaches and tomatoes were contaminated as well as apples. In organoleptically acceptable fruit juices, the contamination rates were 40% for apple juice and 16% for the other juices, such as sour cherry, currant, sea buckthorn juices. The patulin content varied from 20 to 200 µg/l., the mean value being 80 µg/l. It ranged from 0.1 to 5 µg/g in apples and sterile apple preserves. The hygienic-toxicological significance of these findings is discussed; inclusion of patulin in the examination of

foods for mycotoxins is suggested. [See preceding abstr. for part I.] IN

128

Production of mycophenolic acid by *Penicillium roqueforti* strains.

Lafont, P.; Debeaupuis, J.-P.; Gaillardin, M.; Payen, J. *Applied and Environmental Microbiology* 37 (3) 365-368 (1979) [18 ref. En] [INSERM, Unite de Recherche de Toxicologie Alimentaire, 78110 Le Vesinet, France]

16 strains of *P. roqueforti* Thom, isolated from blue-moulded cheeses, were studied. In vitro, all these strains produced mycophenolic acid, some in the order of 0.8-4 mg/g DM. Greatest yields were obtained after 10 days incubation at 15°C. Under some experimental conditions, mycophenolic acid was only partly responsible for the toxic effect of culture extracts on chicken embryos. AS

129

Determination of mycophenolic acid, penicillic acid, patulin, sterigmatocystin, and aflatoxins in cheese.

Siriwardana, M. G.; Lafont, P.

Journal of Dairy Science 62 (7) 1145-1148 (1979)

[12 ref. En] [INSERM, Unite de Recherche de Toxicologie Alimentaire, 44 Chemin de Ronde, 78110 Le Vaset, France]

The method is based on selective extraction with a mixture of equal volumes of 5% NaCl, methanol and acetone, precipitation of caseins at -25°C, defatting with hexane, and removal of extraneous matter by transfer of mycotoxins to chloroform and ethyl acetate. The extract is purified further by column chromatography. Mycotoxins are estimated on TLC chromatograms by fluorescence comparisons. Mycophenolic acid, patulin and penicillic acid are visualized with diethylamine. Limits of detection in cheese are about 20 µg/kg for mycophenolic acid, patulin and sterigmatocystin, 30 µg/kg for penicillic acid, and 1 µg/kg for aflatoxins B₁ and M₁. AS

130

Penicillic acid production by some fungal species in relation to water activity and temperature.

Northolt, M. D.; Egmond, H. P. van; Paulsch, W. E.

Journal of Food Protection 42 (6) 476-484 (1979)

[29 ref. En] [Lab. for Zoonoses & Food Microbiol., Nat. Inst. of Public Health, Bilthoven, Netherlands]

The combined effects of water activity (a_w) and temp. on growth of and penicillic acid (PA) production by strains of *Penicillium cyclopium*, *P. martensii*, and *Aspergillus ochraceus* were determined. On malt agar media in which the a_w had been adjusted by addition of sucrose or glycerol, the min. a_w for PA production by *P. cyclopium* and *A. ochraceus* was 0.97 and that of *P. martensii* was 0.99. The temp. range for PA production by *P. cyclopium* and *P. martensii* was 4-31°C, whereas that of *A. ochraceus* was 8-31°C. Optimum temp. for PA production by *P. cyclopium* and *A. ochraceus* varied with the strain tested and was 24-31°C. The only strain of *P. martensii* tested showed an optimum temp. of 16-24°C. On Gouda and Tilsit cheese of 0.96-0.98 a_w , temp. ranges for growth of *P.*

cyclopium, a common mould on cheese, were 0–24° and 4–16°C, resp. When a strain of *P. cyclopium* known to be able to produce PA in culture media, was grown on Gouda cheese incubated at different temp., no PA was detectable in the mouldy cheese at the time the average colony diam. was 30 mm. However, in a culture on Gouda cheese incubated for a prolonged time (42 days) at 16°C, PA was detectable. On poultry feed, *A. ochraceus* produced PA at a_w as low as 0.88, whereas the min. a_w for PA production by *P. cyclopium* was 0.97. AS

131

Ochratoxin A production by some fungal species in relation to water activity and temperature.

Northolt, M. D.; Egmond, H. P. van; Paulsch, W. E. *Journal of Food Protection* 42 (6) 485–490, 475 (1979) [34 ref. En] [Lab. for Zoonoses & Food Microbiol., Nat. Inst. of Public Health, Postbus 1, Bilthoven, Netherlands]

Effects of water activity (a_w) and temp. on growth of and ochratoxin A (OA) production by strains of *Aspergillus ochraceus*, *Penicillium cyclopium*, and *P. viridicatum* were investigated. On agar media in which the a_w had been adjusted by addition of sucrose or glycerol, the min. a_w values for OA production by *A. ochraceus*, *P. cyclopium* and *P. viridicatum* lay between 0.83 and 0.87, 0.87 and 0.90, and 0.83 and 0.86, resp. At 24°C, optimum a_w values for OA production by *A. ochraceus* and *P. cyclopium* were 0.99 and 0.95–0.99 resp., whereas that of *P. viridicatum* varied and was 0.95 and 0.99 for the 2 strains tested. At optimum a_w , the temp. range for OA production by *A. ochraceus* was 12–37°C, whereas that of *P. cyclopium* and *P. viridicatum* was 4–31°C. Optimum temp. for OA production by *A. ochraceus* was 31°C, whereas that of *P. cyclopium* and *P. viridicatum* was 24°C. On Edam cheese of 0.95 a_w , the min. temp. for OA production by *P. cyclopium* was 20°C. On barley meal, *P. viridicatum* produced maximal quantities of OA at 0.97 a_w and could produce OA at temp. as low as 12°C. AS

132

Territrems, tremorgenic mycotoxins of *Aspergillus terreus*.

Ling, K. H.; Yang, C. K.; Peng, F. T. *Applied and Environmental Microbiology* 37 (3) 355–357 (1979) [8 ref. En] [Inst. of Biochem., Coll. of Med., Nat. Taiwan Univ., Taipei, Taiwan]

The tremorgenic mycotoxins isolated from *Aspergillus terreus* (a fungus which contaminates stored unhulled rice) were given the trivial names territrem A and territrem B instead of their previous designations of C₁ and C₂, resp. High-resolution MS data suggested the molecular formulae to be C₂₈H₃₀O₉ and C₂₉H₃₄O₉, resp. They were partially characterized by UV, IR, proton magnetic resonance, and MS. The spectroscopic evidence indicated that their chemical structures were very similar. Procedures of purification were also revised for the complete separation of these 2 chemically related compounds. [See also following abstr.] AS

133

Differentiation of aflatoxins from territrems.

Ling, K. H.; Yang, C. K.; Huang, H. C. *Applied and Environmental Microbiology* 37 (3) 358–361 (1979) [10 ref. En] [Inst. of Biochem., Coll. of Med., Nat. Taiwan Univ., Taipei, Taiwan]

3 methods were adopted for differentiation of aflatoxins B₁ and B₂ from territrems A and B. (i) TLC coupled with chemical confirmation. A significant decrease in the R_f value of trifluoroacetic acid-treated aflatoxin B₁ developed in chloroform-acetone (85:15, v/v) satisfactorily differentiated this toxin from the other 3. (ii) High-pressure liquid chromatography monitored synchronously at 365 and 335 nm. The ratio derived from this double-wavelength detection could serve as an indicator of the presence of each toxin. (iii) Velasco's flurotoxin meter method, which is used for detn. of aflatoxins in the range 0–50 ng/ml, was not significantly affected by territrems even when they were present at the µg/ml level. [See also preceding abstr.] AS

134

Toxicology, biochemistry and pathology of mycotoxins. [Book]

Uraguchi, K.; Yamazaki, M. (Editors) viii + 288pp. ISBN 0-470-26423-3 (1978) [many ref. En] New York, USA; Halsted Press, John Wiley & Sons Ltd. & Tokyo, Japan; Kodansha Ltd. Price £19.95 [Tokyo Univ. of Agric., Sakuragaoka, Setagayaku, Tokyo 156, Japan]

This book, by leading Japanese workers, gives a broad survey of the occurrence and properties of mycotoxins and their role in human health problems. Chapters are: Introduction, by K. Uraguchi (pp. 1–11, 44 ref.). Current scope of mycotoxin research from the viewpoint of food mycology, by H. Kurata (pp. 13–64, 421 ref.), which includes important mycotoxin-producing fungi, significance of the mycoflora of various foodstuffs (pp. 31–48), surveys on the mycoflora of dietary foods, natural occurrence of mycotoxins in foodstuffs, and control. Chemistry of mycotoxins, by M. Yamazaki (pp. 65–106, 145 ref.). Toxicology and biochemistry of mycotoxins, by Y. Ueno & I. Ueno (pp. 107–188, 162 ref.). Morphological and functional damage of cells and tissues, by K. Tereo & Y. Ueno (pp. 189–238, 165 ref.). Carcinogenicity of mycotoxins, by M. Enomoto (pp. 239–262, 38 ref.). Aflatoxin: investigations on traditional foods and imported foodstuffs in Japan, by K. Aibara (pp. 263–278, 40 ref.). A subject index and index of organisms are included. AL

135

Stability of patulin at pH 6.0–8.0 and 25°C.

Brackett, R. E.; Marth, E. H. *Zeitschrift für Lebensmittel-Untersuchung und -Forschung* 169 (2) 92–94 (1979) [13 ref. En, de] [Dep. of Food Sci., Univ. of Wisconsin-Madison, Madison, Wisconsin 53706, USA]

Patulin was tested for stability at pH values of 6.0, 6.5, 7.0, 7.5 and 8.0, using Sørensen's phosphate buffer at

25°C. Patulin was determined by high-performance liquid chromatography. When % patulin remaining was plotted vs. reaction time, apparent 1st-order reaction plots were obtained. Reaction rate constants for disappearance of patulin ranged from $1.1 \times 10^{-2}/\text{h}$ at pH 8.0 to $5.3 \times 10^{-4}/\text{h}$ at pH 6.0. Values for half-life were calculated and ranged from 64 h at pH 8.0 to 1310 h at pH 6.0. AS

136

[Biological assay for quantitative determination of roquefortine.] Ein biologischer Test zur quantitativen Bestimmung von Roquefortin.

Kopp, B.; Rehm, H.-J.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 169 (2) 90-91 (1979) [7 ref. De, en] [Inst. für Mikrobiol., Univ. Münster, Tibusstrasse 7-15, D-4400 Münster, Federal Republic of Germany]

A simple plate diffusion assay for roquefortine, based on inhibition of *Bacillus stearothermophilus* growth, is described. A thick suspension of *B. stearothermophilus* spores is prepared in standard agar at 70°C, and 10 ml portions are poured into Petri dishes. 8-mm diam. holes are made in the set agar, and dilutions of a standard solution of roquefortine (in dimethylsulphoxide) are pipetted into different holes, and the unknown solution of roquefortine is pipetted into a hole without any prior purification. Plates are kept at room temp. for 3 h, then incubated at 50°C for 5 h. Diam. of zones of inhibition of *B. stearothermophilus* are measured and are linearly related to log roquefortine concn. in the range 25-300 µg/ml. The method is less sensitive than the fluorescence method, but is just as accurate when no other antimicrobial substances exist in a food substrate. If PR-toxin and roquefortine co-exist in cheese, they must be separated prior to assay. DIH

137

[Hygienic significance of sterigmatocystin in foods of vegetable origin. I. Analytical detection of sterigmatocystin.] Zur hygienischen Bedeutung von Sterigmatocystin in pflanzlichen Lebensmitteln.

I. Analytischer Nachweis von Sterigmatocystin.

Thurm, V.; Paul, P.; Koch, C. E.

Nahrung 23 (2) 111-115 (1979) [29 ref. De, en, ru] [Inst. für Exp. Epidemiologie, Wernigerode, German Democratic Republic]

After an initial discussion of the characteristics and toxicology of sterigmatocystin, and published analytical techniques, a TLC procedure for detn. of sterigmatocystin in fruit and vegetable products is described. Sterigmatocystin is extracted with ethyl acetate, dried with Na_2SO_4 , and evaporated to dryness in a rotary vacuum evaporator; the residue is taken up in chloroform, re-evaporated to dryness, and the residue dissolved in benzene. After column-chromatographic clean-up (if required) the sterigmatocystin is separated by TLC on silica gel G, or a silufol prepared plates, using a benzene/methanol/acetic acid (24:2:1) solvent system. After spraying with 20% ethanolic AlCl_3 solution and heating for 10 min at 100°C, sterigmatocystin gives a yellow fluorescent fleck; spraying with saturated methanolic ZrOCl_2 solution

gives a similar result. Detection limit is approx. 20 µg/kg (for a sample wt. of 50 g). The identity of sterigmatocystin may be confirmed by derivatization with trifluoroacetic acid anhydride to form the semi-acetal. [See also following abstr.] AJDW

138

[Hygienic significance of sterigmatocystin in foods of vegetable origin. II. Production of sterigmatocystin by *Aspergillus versicolor*.] Zur hygienischen Bedeutung von Sterigmatocystin in pflanzlichen Lebensmitteln. 2. Zur Bildung von Sterigmatocystin durch *Aspergillus versicolor*.

Paul, P.; Thurm, V.

Nahrung 23 (2) 117-120 (1979) [11 ref. De, en, ru] [Inst. für Exp. Epidemiologie, Wernigerode, German Democratic Republic]

Samples of various foods of fruit and vegetable origin were inoculated with a spore suspension of a toxigenic strain of *Aspergillus versicolor*, then incubated for 14 days at 22°C. The extent of growth of *A. versicolor* was then evaluated, and the product was tested for sterigmatocystin. A table of results is given. Sterigmatocystin concn. in the incubated samples were: apple puree, 2 µg/g; plums, 1.25 µg/g; gooseberry preserves, 9.4 µg/g; sweet cherries, 1.4 µg/g; grapes, 10 µg/g; and grape juice, 66 µg/l. No sterigmatocystin was detectable in samples of tomato puree, pear + orange juice, apple juice and raspberry juice. [See also preceding abstr.] IN

139

[Hygienic significance of sterigmatocystin in foods of vegetable origin. III. The occurrence of sterigmatocystin.] Zur hygienischen Bedeutung von Sterigmatocystin in pflanzlichen Lebensmitteln. 3. Zum Vorkommen von Sterigmatocystin.

Thurm, V.; Koch, C. E.; Paul, P.

Nahrung 23 (2) 121-123 (1979) [6 ref. De, en, ru] [Inst. für Exp. Epidemiologie, Wernigerode, German Democratic Republic]

A total of 142 samples of vegetable foods was examined for the occurrence of sterigmatocystin. The samples examined were fruits and vegetables which had spontaneously gone mouldy or begun to rot under natural conditions, and organoleptically impeccable fruit juices and maize specimens. The samples were taken at the manufacturing plant or procured on the market in the framework of operative controls. Sterigmatocystin was detected in none of the samples under investigation. From this it may be concluded that the risk of its occurrence in vegetable foods is not very great in the German Democratic Republic. Nevertheless, due to its carcinogenic and toxic properties, sterigmatocystin should remain included in the examination for mycotoxins in the framework of food control. [See also preceding abstr.] IN

140

A survey for the presence of mycotoxins in samples of food grains collected in the Tamilnadu region. (In 'Proceedings of the First Indian Convention of Food Scientists and Technologists' [see FSTA (1979) 11

12A871}) [Lecture]

Neelakantan, S.; Balasubramanian, T.; Balasaraswathi, R.; Indra Jasmine, G.; Swaminathan, R.
p. 74, No. 7.1 (1979) [En] [Dep. of Food Tech., Tamilnadu Agric. Univ., Coimbatore, India]

931 samples of grain, mostly rice and wheat, were obtained from godowns and markets in the Tamilnadu region. The samples were ground, extracted with chloroform, filtered, passed through anhydrous Na_2SO_4 , concentrated and analysed for mycotoxins by TLC. 20 samples, most of which were visibly mouldy, contained sterigmatocystin. Other mycotoxins could not be positively identified because of occurrence of interfering fluorescent spots on the TLC plates. JA

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FAB 50

MYCOTOXINS IN FOODS (EXCLUDING AFLATOXINS & MICROBIAL TOXINS)

SELECTED FROM VOLUME **10**

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of

Commonwealth Agricultural Bureaux, Farnham Royal, Bucks; Gesellschaft für Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

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Coverage of the subject has been restricted to that of Food Science and Technology Abstracts, which covers over 1200 of the important food journals, patents from 20 countries and books published world-wide. Every effort is made to include all significant references, but editorial discretion is used on the many articles of borderline interest. If the reader particularly needs an exhaustive search of the subject, we will be pleased to provide any other references that we have available. We would, in any case, encourage readers to write or telephone us with any comments or queries that they may have.

H. BROOKES

ASSISTANT EDITOR

1

Survey of 1975 wheat and soybeans for aflatoxin, zearalenone, and ochratoxin.

Shotwell, O. L.; Goulden, M. L.; Bennett, G. A.; Plattner, R. D.; Hesseltine, C. W.

Journal of the Association of Official Analytical Chemists 60 (4) 778-783 (1977) [12 ref. En] [USDA, N. Regional Res. Cent., Peoria, Illinois 61604, USA]

Wheat samples (102 lots) were collected from Virginia, North Carolina, S. E. Missouri, S. Illinois and Kentucky. Soybean samples (180 lots) were collected from Virginia, Illinois, Iowa, Minnesota, Nebraska, Alabama, Arkansas and Texas. Samples of both commodities were analysed for zearalenone, aflatoxin and ochratoxin by the Eppley method. None of the 3 mycotoxins were detected in soybeans. Aflatoxins and ochratoxin A were not detected in wheat, but zearalenone was detected in 19 of 42 samples collected in Virginia. Half of the Virginia samples were collected because they were mould-damaged. Zearalenone levels ranged from 0.36 to 11.05 ppm; the identity of the zearalenone was confirmed by GLC and MS. *Gibberella zeae* infection (6-60%) was detected in all of the zearalenone-positive samples; 6-60% of the kernels in the samples tested contained *G. zeae*. AS

2

Control of pesticide residues and mycotoxins in food in the US and Canada.

Eades, J. F.

Farm and Food Research 8 (1) 9-10 (1977) [En] [Pesticide Residue & Analytical Services Unit, Oak Park Res. Cent., Carlow, Co. Carlow, Irish Republic]

Information on pesticide residues and mycotoxins in food, gathered on a visit to US and Canadian government agencies and other institutions in July/Aug., 1975, is discussed. Sampling of food and feed for pesticide residues, inspection of firms engaged in different aspects of the food industry, and the total diet concept for estimation of pesticide residues, are discussed. Of the mycotoxins found in food, the main interest centres around aflatoxin. VJG

3

[Mycotoxins in musts and wines manufactured from apples contaminated with moulds.]

Pogorzelski, E.; Masiar, M.; Czyzycki, A.; Lukawska-Pietrzak, Z.; Adamow-Piaszczyńska, M. *Przemysł Fermentacyjny i Rolny* 21 (5) 11-15 (1977) [20 ref. Pl, ru, en] [Inst. Tech. Fermentacji i Mikrobiologii Politechniki Łódzkiej, Łódź, Poland]

The effect of mould-contaminated apples on must quality was studied. The toxigenic moulds involved include 19 spp. of *Aspergillus*, 13 of *Fusarium* and 14 of *Penicillium*. To date, 8 fractions have been isolated: B₁, B₂, G₁, G₂, M₁, M₂ and B_{2a} and G_{2a}. The most toxic was B₁ and the least toxic B₂. During model experiments, 10-50% mould infested apples were used; must

fermentation proceeded well, and the wine had good colloidal stability. The methanol content of the wines was 800 mg/l., vs. 93 mg/l. in wine produced entirely from sound apples. Wine produced from 50% contaminated apples contained approx. 15.5 µg aflatoxin B₁/l., approx. 31.0 µg aflatoxin G₁/l. and traces of aflatoxins B₂ and G₂. The same samples contained 15 mg patulin/l. STI

4

Production of refusal factors by *Fusarium* strains on grains.

Vesonder, R. F.; Ciegler, A.; Jensen, A. H. *Applied and Environmental Microbiology* 34 (1) 105-106 (1977) [12 ref. En] [N. Regional Res. Cent., ARS, Peoria, Illinois 61604, USA]

The conditions under which toxic trichothecenes are produced on *Fusarium*-infected grains were studied. Toxic *Fusarium* strains, *F. graminearum* NRRL 5883, *F. culmorum* NRRL 3288, *F. poae* NRRL 3287, *F. moniliforme* NRRL 3197 and *F. nivale* NRRL 3289, were cultured on corn (35-40% moisture) at 28°C for 13 days. Corn fermented by each strain was fed to 13.6-27.2 kg swine. All strains induced a refusal response comparable to that given by corn naturally infected with *Fusarium*. Analysis of the corn by TLC showed that corn fermented by strains *F. culmorum* NRRL 3288 and *F. graminearum* NRRL 5883 contained vomitoxin, but none was produced by the other strains. Studies on rice (35-40% moisture) fermented for 13 days at 25°C showed vomitoxin production by *F. culmorum* only. The data suggest that fermentation conditions influence which toxic trichothecenes will be produced. SP

5

[Significance of mycotoxins from the health point of view.] Zur gesundheitlichen Bedeutung der Mykotoxine. [Review]

Roll, R.

Zeitschrift für das Gesamte Lebensmittelrecht (ZLR) 4 (2) 187-198 (1977) [40 ref. De, en, fr]

6

Ochratoxin A residues in tissues of slaughter pigs with nephropathy.

Krog, P.

Nordisk Veterinærmedicin 29 (9) 402-405 (1977) [12 ref. En, da] [Frederik V's vej 11, DK-2100 Copenhagen, Denmark]

Kidneys showing nephropathy changes were collected from slaughtered pigs at 7 slaughterhouses in Denmark. Ochratoxin A residues ≥ 2 µg/kg were detected in 21 of 60 kidneys (35%). Ochratoxin A residues in liver, muscular and adipose tissues were calculated on the basis of the kidney concn. Although the 21 kidneys containing ochratoxin A were condemned, the carcasses passed the meat inspection. Routinely, only a small fraction of pigs exhibits nephropathy changes at slaughter, but the results of this study provide indirect evidence for a limited occurrence of ochratoxin A residues in commercial meat. AS

7

Examination of cider vinegar for patulin using mass spectrometry.

Ralls, J. W.; Lane, R. M.

Journal of Food Science 42 (4) 1117-1119 (1977) [14 ref. En] [W. Res. Lab., Nat. Canners Ass., Berkeley, California 94710, USA]

A method for the analysis of patulin in vinegar was developed using gas chromatography-MS of patulin acetate. Using selective m/e scanning, patulin acetate can be measured down to a level of 0.04 p.p.m. with a 100 ml sample of vinegar. Commercial samples of vinegar showed no detectable level of patulin. A series of samples fortified with patulin (2.5 mg/200 ml) were extracted after 1, 2, 7 and 11 days of ambient storage. 92% of the patulin was converted to nondetectable products in the 1st 24 h of storage. IFT

8

A radioimmunoassay for ochratoxin A: a preliminary investigation. (In 'Proceedings of the 20th World Veterinary Congress' [see FSTA (1978) 10 3G126].) [Lecture]

Aalund, O.; Brunfeldt, K.; Hald, B.; Krogh, P.; Poulsen, K.

1, 1293-1296 (undated) [5 ref. En]

Studies on development of a radioimmunoassay for ochratoxin A are described; rabbit anti-ochratoxin A antibodies were used, with ¹²⁵I-labelled egg albumen-ochratoxin A as the radioactive antigen. Max. immunoprecipitation was approx. 20%; an antibody titration curve is given showing the relationship of counts/min and relative immunoprecipitation to the reciprocal titre. Inhibition by free ochratoxin A was also studied; significant interference was observed. Serum components may also interfere. Detection limit of the method is probably approx. 20 parts/billion. AJDW

9

[Moulds in modern nutrition.]

Ligugnana, S.

Tecnica Molitoria 28 (9) 164-167 (1977) [It]

Aspects discussed include: beneficial activity of moulds in the manufacture of various foods; contamination of foods by moulds; formation of mycotoxins; cleaning and disinfection of walls, ceilings, etc. in food processing and handling establishments, to control moulds; and prevention of contamination of food with moulds from the air. AJDW

10

Toxicological study of patulin in monkeys.

Garza, H. C.; Swanson, B. G.; Brannen, A. L. *Journal of Food Science* 42 (5) 1229-1231, 1235 (1977) [29 ref. En] [Dep. of Food Sci. & Tech., Washington State Univ., Pullman, Washington 99164, USA]

Patulin, 4-hydroxy-4H-furo-[3,2-c]-pyran-2(6H)-one, a mycotoxin produced by certain *Aspergillus* and *Penicillium* spp., has been found as a contaminant of apple products. Patulin has resulted in toxicological effects in mice and rats; however, little information is available on the oral toxicity of patulin to primates. In this study, pig-tail monkeys (*Macaca nemestrina*) were given daily oral doses of patulin for a period of 4 wk. No statistically significant changes were observed in physiological parameters, with the exception of alkaline phosphatase which decreased as patulin dosages increased. IFT

11

Comparative study of the fluorescent characteristics of solutions of aflatoxins and palmotoxins in chloroform.

Uwaifo, A. O.; Emerole, G. O.; Bassir, O.

Journal of Agricultural and Food Chemistry 25 (5) 1218-1220 (1977) [15 ref. En] [Dep. of Biochem., Univ. of Ibadan, Ibadan, Nigeria]

Palmotoxins B₀ and G₀ and aflatoxins B₁, B₂, G₁, G₂, and B₃ were all excited in chloroform at a wavelength of 365 nm. Their fluorescence emission max. fell within the wavelength range 410-430 nm. The fluorescence of aflatoxins and palmotoxins in descending order of intensity is as follows: G₂ > G₁ > G₀ > B₃ > B₀ > B₂ > B₁. The UV absorption max. for the aflatoxins and palmotoxins used are recorded. AS

12

Production and stability of aflatoxins, penicillic acid and patulin in several substrates.

Lieu, F. Y.; Bullerman, L. B.

Journal of Food Science 42 (5) 1222-1224, 1228 (1977) [32 ref. En] [Dep. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, Nebraska 68583, USA]

Aflatoxins B₁ and G₁, penicillic acid and patulin were each added to Swiss cheese, bologna and cooked cornmeal. The samples were stored at 5°C for 15 min and 3, 12, 24, 48, 120 and 168 h before extraction and recovery of the added toxins. Aflatoxins B₁ and G₁ were stable in the foods during the entire storage period. Patulin and penicillic acid were undetectable in bologna after 12 and 48 h storage, resp. In Swiss cheese, after 168 h of storage at 5°C, 8% of the original penicillic acid remained. With cooked cornmeal, about 80% of the patulin and of the penicillic acid were detected after 168 h of storage at 5°C. Growth and experimental toxin production on several substrates were studied by using known toxinogenic strains of *Aspergillus flavus*, *Penicillium patulum* and a *Penicillium* sp. incubated at 5°, 12° and 25°C for 6, 4 and 2 wk resp. No growth of *A. flavus* or aflatoxin production was observed at 5°C and 12°C on any substrate, but at 25°C, growth and aflatoxin production occurred on Swiss cheese, bologna, cooked cornmeal, Mozzarella cheese and bacon. Patulin and penicillic acid were produced in cooked cornmeal at all 3 temp., but were not found in the

other food substrates, except for a small amount of penicillic acid in one of the muffin samples at 5°C, even though the moulds grew extensively on all substrates at all 3 temp. IFT

13

Determination of patulin in apple juice products as the 2,4-dinitrophenylhydrazone derivative.

Stinson, E. E.; Huhtanen, C. N.; Zell, T. E.; Schwartz, D. P.; Osman, S. F.

Journal of Agricultural and Food Chemistry 25 (5) 1220-1222 (1977) [12 ref. En] [E. Regional Res. Cent., USDA, Philadelphia, Pennsylvania 19118, USA]

A method to determine patulin, 4-hydroxy-4H-furo[3,2-c]pyran-2(6H)-one, in apple juice products as the 2,4-dinitrophenylhydrazone (2,4-DNPH) derivative was developed. Patulin was derivatized by means of a micro reaction column packed with Celite-2,4-dinitrophenylhydrazine-66% H_3PO_4 and eluted with methylene chloride. The derivative was isolated by TLC and detected by spraying with base to produce a wine-red spot. Quantitation of the patulin derivative scraped from the thin-layer plate and extracted in solvent was by UV absorbance at 375 nm, the characteristic absorption max. of the patulin 2,4-DNPH derivative. Satisfactory recoveries (64-104%) were obtained from patulin added to apple juice at levels of 50-340 ng/ml. The lower limit of detection was approx. 50 ng/ml. AS

14

Effect of water activity on disappearance of patulin and citrinin from grains.

Harwig, J.; Blanchfield, B. J.; Jarvis, G.

Journal of Food Science 42 (5) 1225-1228 (1977) [30 ref. En] [Health & Welfare Canada, Health Protection Branch, Tunney's Pasture, Ottawa, Ontario K1A 0L2, Canada]

Sterile ground barley, corn and wheat were adjusted to different water activities (a_w) and intentionally contaminated with patulin and citrinin. Samples were incubated at 25°C at an RH in equilibrium with their a_w . Toxin levels were determined by TLC after different periods of incubation. Disappearance rates were greater in substrates with a higher a_w . At $a_w = 0.70$, estimates of half-lives for patulin in barley, corn and wheat were 12.7, 4.4 and 4.4 days, resp.; at an a_w of 0.90 they were 6.8, 2.4 and 1.9 days. For citrinin, these values were 7.8, 15.5 and 11.9 days at $a_w = 0.70$, and 1.8, 10.4 and 3.0 days at $a_w = 0.90$. Because of these short half-lives grains that were responsible for a mycotoxicosis may, at the time of analysis, contain only low levels of these toxins. IFT

15

Safety of *Penicillium caseicolum*, *P. camemberti* and *P. roqueforti* for human health. I. Physico-chemical methods for measuring known mycotoxins. Die gesundheitliche Unbedenklichkeit

von *Penicillium caseicolum*, *P. camemberti* und *P. roqueforti*: I. Prüfung auf Bildung bekannter Mykotoxine mit physikalisch-chemischen Methoden.

Engel, G. von; Milczewski, K. E. von *Milchwissenschaft* 32 (9) 517-520 (1977) [33 ref. De, en] [Inst. für Mikrobiol. der Bundesanstalt für Milchforschung, Kiel, Federal Republic of Germany]

36 strains of *P. caseicolum*, 5 of *P. camemberti*, and 17 of *P. roqueforti* were tested for their ability to form aflatoxins B_1 , B_2 , G_1 , G_2 and M_1 , sterigmatocystin, diacetoxyscirpenol, ochratoxin A, patulin, penicillic acid, citrinin, and citreoviridin; surface cultures of the individual strains in yeast extract/sucrose were incubated for 10-14 days at 27°C and extracted with acetonitrile/chloroform at pH 1.5. After TLC the conc. extracts were examined spectrometrically. No mycotoxins were produced by any of the 3 *Penicillium* spp. tested. AS

16

[Biological detection test of aflatoxin B_1 and patulin mycotoxins using *Bacillus thuringiensis*.]

Boutibonnes, P.; Jacquet, J.

Bulletin de l'Academie Veterinaire de France 49 (4) 491-502 (1976) [27 ref. Fr] [Lab. de Physiologie Bacterienne II, Univ. de Caen, 14032 Caen, France]

Biological tests to ascertain the effect of (i) coumarin and related molecules, (ii) S compounds (cysteine, cystine, thiourea and sodium thiosulphate and thioglycollate), and (iii) steroid hormones on the cytotoxic powers of mycotoxins (aflatoxin B_1 and patulin) were carried out using *B. thuringiensis*. Double soaking ($2 \times 20 \mu\text{l}$ doses on No. 1 Whatman filter paper strips) and direct contact (5 or 10 μg doses) methods were used with both mycotoxins, together with (i), (ii) or (iii) on cultures in a solid medium. Whereas *B. thuringiensis* was sensitive to both mycotoxins alone (2 $\mu\text{g}/\text{ml}$ inhibited growth completely in either case), (i) inhibited antibacterial activity of aflatoxin B_1 , and (ii) inhibited that of patulin; (iii) had no effect. It is concluded that biochemical control of foodstuffs should be coupled with biological tests for distinguishing natural compounds so as to improve hygienic standards. KME

17

[Safety of *Penicillium caseicolum*, *P. camemberti* and *P. roqueforti* to human health. II. Biological testing of toxin formation ability on cell cultures.]

Die gesundheitliche Unbedenklichkeit von *Penicillium caseicolum*, *P. camemberti* und *P. roqueforti*. II. Biologische Prüfung auf Toxinbildungsvermögen an Zellkulturen. Krusch, U.; Lompe, A.; Engel, G.; Milczewski, K. E. von *Milchwissenschaft* 32 (12) 713-715 (1977) [10 ref. De, en]

36 strains of *P. caseicolum*, 5 of *P. camemberti* and 18 of *P. roqueforti* were examined by biological

tests for their ability to form toxins. The microorganisms were cultivated on a yeast-extract-sucrose medium at 27°C. Human cells were treated with culture extract for 4 days and then examined histologically. No toxin formation by *P. caseicolum* or *P. camemberti* was detected. One of the 18 strains of *P. roqueforti* was toxigenic. The formation of PR toxin by the latter strain has been reported in the literature. [See FSTA (1978) 10 3P329 for part I.] AS

18

The fate of ochratoxin A in rats.

Chang, F. C.; Chu, F. S.

Food and Cosmetics Toxicology 15 (3) 199-204 (1977) [23 ref. En] [Food Res. Inst., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

The fate of ochratoxin A, one of the most potent nephrotoxins among a series of ochratoxins produced by several spp. of *Aspergillus* and *Penicillium*, was studied in rats given a single interperitoneal injection of 1 mg labelled with ¹⁴C. Ochratoxin A reached its highest levels in serum (90%), liver and kidney. It was excreted primarily in the urine, either as the unchanged toxin or its metabolites. The in vivo binding of the toxin with serum albumin is described. VJG

19

Ochratoxin A and the kidney.

Cooper, P.

Food and Cosmetics Toxicology 15 (3) 246-247 (1977) [12 ref. En]

Consideration is given to ochratoxin, its occurrence in foodstuffs, and to endemic nephropathy. Recent work on ochratoxicosis in pigs, beagle dogs, rats and broiler chicks is reviewed. VJG

20

Screening method for the detection of aflatoxins, ochratoxin, patulin, sterigmatocystin, and zearalenone in cereals.

Josefsson, B. G. E.; Möller, T. E.

Journal of the Association of Official Analytical Chemists 60 (6) 1369-1371 (1977) [13 ref. En] [Swedish Nat. Food Admin., Food Lab., S-751 26 Uppsala, Sweden]

A 50-g cereal meal sample is extracted by shaking with 25 ml 0.1M H₃PO₄ + 250 ml chloroform. Corn meal samples are extracted in a high speed blender, not by shaking. The extract is filtered and 25 ml filtrate is evaporated to 0.25 ml. This is cleaned up by chromatography on Sephadex LH-20 using chloroform/methanol (2 + 1) as eluent. For a 59 cm × 15 mm column, a fraction between 53 and 75 ml is collected for detn. of all the mycotoxins named in the title, except patulin (PT), for which a fraction between 76 and 90 ml is collected. After evaporation to near dryness, each fraction is dissolved in 100 µl chloroform. 5-20 µl spots are applied to a TLC plate which is developed once in benzene/hexane (3 + 1) (mycotoxins

remain at origin) and once in benzene/ethyl acetate/formic acid (80 + 20 + 0.5). PT is determined on a separate plate developed in the 2nd solvent system. Lowest detectable levels in meals of wheat, barley, rye, oats and corn are: aflatoxins, 5 µg/kg; ochratoxin A, 10 µg/kg; PT, 50 µg/kg; sterigmatocystin, 10 µg/kg; and zearalenone, 35 µg/kg. DIH

21

Patulin production by *Byssoschlamys* spp. in fruit juices.

Rice, S. L.; Beuchat, L. R.; Worthington, R. E. *Applied and Environmental Microbiology* 34 (6) 791-796 (1977) [29 ref. En] [Dep. of Food Sci., Univ. of Georgia Agric. Exp. Sta., Experiment, Georgia 30212, USA]

10 strains of *Byssoschlamys fulva* and 3 strains of *B. nivea* were cultured in a laboratory medium and tested for their ability to produce patulin. 2 strains of *B. fulva* and all 3 strains of *B. nivea* produced the mycotoxin. One strain of *B. fulva* produced patulin in 11 of 13 processed fruit juices, with the greatest amounts being produced in blueberry, red raspberry, and boysenberry juices, whereas no patulin was detected in prune or tomato juices. Grown in Concord grape juice at 18°, 25°, 30°, and 38°C, this strain produced the highest patulin concn. at 18°C after 25 days, whereas biomass production was greatest at 25° and 30°C after 20 and 25 days, resp. AS

22

[Fungi and patulin in fruit and berries.]

Andersson, A.; Josefsson, E.; Nilsson, G.; Akerstrand, K.

Var Föda 29 (8/9) 292-298 (1977) [9 ref. Sv, en] [Livsmedelslab., Statens Livsmedelsverk, 75126 Uppsala, Sweden]

Studies were conducted on the mould count, mycoflora and patulin content of a total of 64 samples of fruit and berries. Median values for mould counts of individual fruit types (with number of samples studied in parentheses) were (counts/g fruit pulp); blueberries (12) 20 000; raspberries (10) 40 000; strawberries (10) 3000; cherries (10) 500; lingonberries (2) 1700; peaches (8) 4000; plums (6) 5000; and blackcurrants (6) 200 000. Predominant mould genera included *Penicillium*, *Cladosporium*, *Botrytis*, *Alternaria* *Aspergillus* and *Fusarium*. Patulin was detected in only 4 samples, one each of blueberries (at 21 µg/kg pulp), lingonberries (265 µg/kg pulp), peaches (6 µg/kg pulp) and plums (4 µg/kg pulp). Of these, only the value for the lingonberries exceeded the Swedish tolerance. If samples of blueberries and raspberries were stored for 1 wk at +15°C, appreciable mould growth and patulin formation were observed. AJDW

23

Mycotoxins in foodstuffs. X. Production of citrinin by *Penicillium chrysogenum* in bread.

Reiss, J.

Food and Cosmetics Toxicology 15 (4) 303-307

(1977) [49 ref. En] [Mikrobiol. Lab.,

Grahamhaus Studt KG, 6550 Bad Kreuznach, Federal Republic of Germany]

Penicillium chrysogenum produced citrinin on whole wheat bread, whole wheat bread with wheat germ, whole wheat bread with linseed, whole rye bread with shredded wheat, and rye bread with wheat flour, but 2 other moulds (*Penicillium* sp. and *Aspergillus niveus*), known to be able to form this mycotoxin, were not able to do so on these types of bread. The highest yields, found in whole wheat bread, were in the range 0.2-0.4 µg/g bread. The growth of *P. chrysogenum* and (to a less marked degree) the toxin production were influenced by the total acid content (Säuregrad), which had to be <9 for activity to be maintained, and by the temp. The optimal temp. for growth and for citrinin formation were 30° and 25° C, resp. [See FSTA (1976) 8 11M1340 for part VI.] AS

24

[Potential mycotoxin producers in dried milks for infants.] Zur Problematik der potentiellen Mykotoxinproduzenten in Milchpulvern für Kleinstkinder.

Jesenska, Z.; Polakova, O.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 166 (1) 1-4 (1978) [38 ref. De, en]

[Res. Inst. for Hygiene, Ul. Cs. Armady 10, 882 01 Bratislava, Czechoslovakia]

11 119 colonies of 29 genera of moulds were isolated from 4950 g dried milk for infant feeding, produced in Czechoslovakia (5 brands in 7 original packages) or in other countries (4 brands in 8 original packages). Average colony count/g was 1.9 for the Czechoslovak samples and 0.1 for the other samples. From one Czechoslovak sample 5402 mould colonies were isolated (18 colonies/g), of which 99.4% were *Penicillium* spp. and 84% were isolated from the 2 top layers of the original package. In the remaining samples the moulds were evenly distributed. 83% of all colonies belonged to the genera *Cladosporium*, *Penicillium* and *Alternaria*. Certain species were potential mycotoxin producers. The results are discussed in relation to the recent finding of aflatoxin B₁ in the livers of deceased infants in Czechoslovakia, and attention is drawn to the need for re-appraisal of microbiological standards and methods of manufacture and packaging for dried milk products for infant feeding. ADL

25

The taxonomy of *Penicillium* species from fermented cheeses.

Samson, R. A.; Eckardt, C.; Orth, R.

Antonie van Leeuwenhoek 43 (3/4) 341-350

(1977) [46 ref. En] [Centraalbureau voor Schimmelcultures, Baarn, Netherlands]

The taxonomy of the *P. camemberti* and *P. roqueforti* series is reinvestigated. *P. caseicolum* Bainier is regarded as a synonym of *P. camemberti* Thom on the basis of morphological characteristics. *P. casei* Staub is considered to be identical with *P. verrucosum* Dierckx var. *cyclopium* (Westling) Samson, Stalk et Hadlok. Descriptions and illustrations of *P. camemberti* and *P. roqueforti* Thom are given. The occurrence and mycotoxin production of both spp. are discussed briefly. AS

26

Third International IUPAC Symposium on mycotoxins in foodstuffs. [Conference proceedings] International Union for Pure & Applied Chemistry

Pure and Applied Chemistry 49 (11) 1703-1778

(1977) [many ref. En]

Part of this issue of the journal contains invited lectures presented at the Third International IUPAC Symposium on mycotoxins in foodstuffs, held at Paris, France, on 16-18 Sept. 1976. Papers include: Food mycotoxins survey and monitoring programs, by A. D. Campbell (pp. 1703-1707, 21 ref.); Mode of action of mycotoxins [aflatoxins and PR toxin], by Y. Moule (pp. 1733-1736, 33 ref., Fr, en); Mode of action of trichothecenes, by Y. Ueno (pp. 1737-1745, 43 ref.); Mode of action and human health aspects of aflatoxin carcinogenesis, by W. H. Butler & G. E. Neal (pp. 1747-1751, 23 ref.); Short-term tests and mycotoxins, by C. Malaveille & H. Bartsch (pp. 1753-1757, 36 ref.); Review of prevention, elimination, and detoxification of aflatoxins, by L. A. Goldblatt & F. G. Dollear (pp. 1759-1764, 35 ref.); and The mycotoxins and human health hazards, by C. A. Linsell (pp. 1765-1769, 31 ref.). A further 4 papers are abstracted separately and are in the FSTA author index under International Union for Pure & Applied Chemistry [Mycotoxins Symposium]. AL

27

Binding of patulin and penicillic acid to glutathione and cysteine and toxicity of the resulting adducts.

Lieu, F. Y.; Bullerman, L. B.

Milchwissenschaft 33 (1) 16-20 (1978) [17 ref.

En, de] [Dep. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, Nebraska 68583, USA]

Adducts of patulin and penicillic acid with glutathione or cysteine did not inhibit growth of *Bacillus subtilis* and were non-toxic in brine shrimp larvae tests. Only the penicillic acid-cysteine adduct exhibited some toxicity for chicken embryos. Combination of patulin and penicillic acid with SH compounds was rapid at pH 7-8. Peptic digestion of the S-alkylated adducts of the toxins did not regenerate free toxins. In foods that are high in protein, such as dairy and meat products, patulin and penicillic acid are probably rapidly inactivated. This would tend to minimize hazards associated with growth of toxin-producing moulds in foods such as mature cheeses and salami. MEG

28

Mycotoxin tolerances in foodstuffs. [Lecture]
Krogh, P.

Pure and Applied Chemistry 49 (11) 1719-1721
(1977) [7 ref. En] [Univ. Inst. of Path. Anatomy,
DK-2100 Copenhagen 0, Denmark]

The action taken by many countries regarding mycotoxins in food and feed, under legislative provision or Code of practice, is discussed. So far, only aflatoxin has been dealt with specifically in legislation; tolerances for foods vary from 0 (level set by analytical method) through 30 to 50 parts/billion. [See FSTA (1978) 10 7C222.] AL

29

Metabolism of aflatoxin and other mycotoxins in relation to their toxicity and the accumulation of residues in animal tissues. [Lecture]

Patterson, D. S. P.

Pure and Applied Chemistry 49 (11) 1723-1731
(1977) [33 ref. En] [Cent. Vet. Lab., Weybridge,
Surrey KT15 3NB, UK]

Mycotoxin metabolism is discussed in relation to detoxification, toxic residues in animal tissues used as food, and metabolic activation. Aflatoxins, sterigmatocystin, ochratoxin A, trichothecenes and zearalenone are considered. [See FSTA (1978) 10 7C222.] AL

30

Some new mycotoxins. [Lecture]

Steyn, P. S.

Pure and Applied Chemistry 49 (11) 1771-1778
(1977) [58 ref. En] [Nat. Chem. Res. Lab., PO
Box 395, Pretoria 0001, South Africa]

Advances on the structural chemistry of some recently discovered mycotoxins, e.g. the tremorgens, cytochalasins, austocystins, tetramic acids, azaphilones and cyclic peptides, are briefly reviewed. [See FSTA (1978) 10 7C222.] AS

31

Simultaneous production of penicillic acid and patulin by a *Penicillium* species isolated from Cheddar cheese.

Olivigni, F. J.; Bullerman, L. B.

Journal of Food Science 42 (6) 1654-1657, 1665
(1977) [24 ref. En] [Dep. of Food Sci. & Tech.,
Univ. of Nebraska-Lincoln, Lincoln, Nebraska
68583, USA]

A *Penicillium* sp. isolated from Cheddar cheese and tentatively identified as an atypical strain of *P. roqueforti* was found to produce penicillic acid and patulin simultaneously. In this study 3 substrates known to support mycotoxin production (yeast-extract sucrose, potato-dextrose and Raulin-Thom broths), a medium containing lactose and casein, several foods (Cheddar cheese, Swiss cheese, sausage, cooked maize meal, yellow dent maize and maize tortillas), and a shredded wheat-nutrient broth medium known to support toxin production were used as substrates. Incubation temp. of 5°, 12°

and 25°C were studied over several periods of time for each group of substrates. Of all the substrates studied, the broth substrates previously known to support mycotoxin production supported the most abundant toxin production under all conditions. The greatest concn. of toxins were produced at 12°C followed by 5°C. The lowest quantities of both mycotoxins were produced at 25°C regardless of substrate. Patulin was produced predominantly on potato-dextrose broth, both penicillic acid and patulin were produced on yeast extract-sucrose broth, and penicillic acid was predominantly produced on Raulin-Thom broth. Neither toxin was produced on Cheddar cheese, Swiss cheese, summer sausage or maize tortillas, but penicillic acid was produced on cooked maize meal and both penicillic acid and patulin were produced on yellow dent maize, with best production occurring at 12°C. Substrates low in carbohydrate did not support appreciable levels of mycotoxin production. IFT

32

Basic techniques in studying mycotoxins: isolation of mycotoxins.

Cole, R. J.

Journal of Food Protection 41 (2) 138-140 (1978)
[10 ref. En] [Nat. Peanut Res. Lab., USDA,
S. Region, PO Box 637, Dawson, Georgia 31742,
USA]

The basic techniques used and the potential problems encountered in isolation of mycotoxins from naturally contaminated commodities and fungal cultures are discussed. Specifically presented are the factors to be considered in selecting a bioassay organism, methods of preparing formulations for mycotoxin administration, modes of administration, methods available for purification, and problems encountered during purification. AS

33

Symposium on mycotoxicology food and feed contamination. [Conference proceedings]

United States of America, American
Phytopathological Society

Proceedings of the American Phytopathological Society 3, 99-172 (1976) [many ref. En]

The full text of papers presented at the 68th Annual Meeting of the American Phytopathological Society, Kansas City, Missouri, July 13, 1976 is given, and includes papers on: Introduction and historical perspectives in mycotoxicology research, by R. E. Pettit & R. A. Taber (pp. 99-109, 34 ref.); Mycotoxins and the fungi that produce them, by C. J. Mirocha & C. M. Christensen (pp. 110-125, 44 ref.); and Mycotoxicoses in animals and humans, by W. W. Carlton (pp. 140-155, 60 ref.). A further 2 papers are abstracted separately and are in the author index under United States of America, American Phytopathological Society [Mycotoxicology Symposium]. SP

34

[Mycotoxins in foods (review of the literature).]
[Review]

Kravchenko, L. V.

Voprosy Pitaniya No. 2, 3-12 (1978) [63 ref. Ru]
[Inst. Pitaniya AMN SSSR, Moscow, USSR]

This review includes a 4-pp. table listing the types of mycotoxins found in foods, the chemical structure, producing organism, natural substrate, toxic effect, and the spp. of animal (including man) affected by them. HBr

35

Environmental factors influencing mycotoxin formation in the contamination of foods. [Lecture]
Diener, U. L.

Proceedings of the American Phytopathological Society 3, 126-139 (1976) [37 ref. En] [Dep. of Botany & Microbiol., Auburn Univ. Agric. Exp. Sta., Auburn, Alabama 36830, USA]

Environmental factors influencing mycotoxin formation in foods are discussed. Mycotoxins and mycotoxicoses considered include: ergotism; Stachybotrys toxin; alimentary toxic aleukia; slaframine; sporidesmins; rubratoxin B; sterigmatocystin; yellow rice toxins; nivalenol and fusarenol X; zearalenone (F-2); T-2 toxin; vomitoxin; penicillic acid; patulin; aflatoxin; and ochratoxin A. [See FSTA (1978) 10 8C268.] SP

36

[Moulds and mycotoxin formation in bread and bakery products.] Schimmelpilze und Mycotoxinbildung auf Brot und Backwaren.

[Review]

Reiss, J.

Getreide, Mehl und Brot 31 (10) 265-270 (1977)
[47 ref. De] [Grahamhaus Stud KG, Dürerstrasse 24, 6550 Bad Kreuznach, Federal Republic of Germany]

Many moulds produce valuable antibiotics, enzymes and plant acids and hormones. However, in 1960 it was found that moulds growing on bread produced mycotoxins which are dangerous to animals and man. Much data on aflatoxins have been collected in the tropics. Aflatoxin has been found by various authors in bread, flour, semolina and other wheat products. It has been found that no connection exists between temp. optimum for mould growth and temp. optimum for toxin formation. Aflatoxin growth in bread is not fully understood. It is found to decrease during mixing and to reappear during baking. Aflatoxins can be separated by silica gel TLC. A quick method for isolating aflatoxins from bread consists of placing pieces of bread on a substrate of tryptone, yeast extract, iron citrate and agar (Aspergillus differential medium) and if aflatoxin is present a yellow colour will appear. In wrapped bread it is found that the lower the O₂ permeability of the wrapping material, the less the mould and aflatoxin growth. High acidity, as in pumpernickel, also inhibits aflatoxin growth. Patulin is another

mycotoxin which has been isolated from penicillium and aspergillus. It has also been found in bread and cakes and has a temp. optimum from 10° to 25° C. It has been found that concn. decreases in bread with increasing incubation time. It is thought that -SH groups and a pH of 5 inactivate patulin. Sterigmatocystin and citrinin are 2 other mycotoxins which have been isolated. Physical or chemical treatments which help to inhibit mycotoxin formation in bread include UV irradiation and addition of calcium propionate, sorbic acid, sorbylpropionate, citric acid and lactic acid. JVR

37

Wild rice as fermentation substrate for mycotoxin production.

Lindenfelser, L. A.; Ciegler, A.; Hesseltine, C. W.
Applied and Environmental Microbiology 35 (1) 105-108 (1978) [16 ref. En] [N. Regional Res. Cent., USDA, Peoria, Illinois 61604, USA]

Many cereal grains have been studied for their suitability as substrates for the fermentative production of mycotoxins. However, except for aflatoxin, wild rice has not been investigated. Hence, 5 mould cultures known to produce the mycotoxins ochratoxin-A, penicillic acid, patulin, vomitoxin and zearalenone were grown on wild rice under varying conditions of moisture and temp. to determine whether this grain would serve as a suitable substrate for toxin production. Under appropriate fermentation conditions, good yields of ochratoxin-A and moderate amounts of patulin were obtained, but only small amounts of penicillic acid, vomitoxin, and zearalenone were elaborated. An extract from a sample of naturally moulded wild rice contained 0.8 µg patulin/g rice. The predominating mould was identified as *Aspergillus clavatus*. Under identical cultural conditions, this isolate and a known patulin-producing strain of *A. clavatus* yielded approx. equivalent amounts of the mycotoxin. AS

38

Patulin production by species of *Aspergillus* and *Penicillium* at 1.7, 7.2 and 12.8° C.

Lovett, J.; Thompson, R. G., Jr.

Journal of Food Protection 41 (3) 195-197 (1978)
[17 ref. En] [Div. of Microbiology, US Dep. of Health, Education & Welfare, Cincinnati, Ohio 45226, USA]

2 strains each of *Aspergillus clavatus* (NRRL 1980 and ATCC 9599), *Penicillium claviforme* (NRRL 1001 and 1002), *P. expansum* (FM 1071 and NRRL 973), and *P. patulum* (ATCC 24550 and FM 1172); and 1 strain of *P. griseofulvum* (NRRL 2300) were inoculated into potato-dextrose broth and incubated at 1.7°, 7.2° and 12.8° C for 110, 84 and 55 days, resp. All cultures grew at all temp. Patulin production by *P. griseofulvum* and *P. claviforme*, NRRL 1001, was limited or inhibited at 1.7° C, whereas at 7.2° C only *P. griseofulvum*, NRRL 2300 failed to produce toxin. Patulin was produced at 12.8° C by all 9 cultures. AS

39

Mycotoxins in foodstuffs. [Conference proceedings]

International Union of Pure & Applied Chemistry; France, Comité National de la Chimie; France, Comité National des Sciences de la Nutrition *Annales de la Nutrition et de l'Alimentation* 31 (4/5/6) 403-1030 (1977) [many ref. En, Fr]

The 3rd International IUPAC Symposium on mycotoxins in foods was held in Paris on 16-18 Sept. 1976. Proceedings dealt with the occurrence and bioproduction of mycotoxins, tolerance, newly discovered mycotoxins, toxicity, mode of action, metabolism and public health aspects. Papers presented include Water soluble toxins of *Stachybotrys alternans* [isolated from grain mixtures], by M. Nummi & M.-J. Niku-Paavola (pp. 761-769, 6 ref.); Mode of action and human health aspects of aflatoxin carcinogenesis, by W. H. Butler & G. E. Neal (pp. 949-956, many ref.); and The mycotoxins and human health hazards, by C. A. Linsell (pp. 997-1004, many ref.). 38 papers are individually abstracted, and are in the FSTA author index under International Union of Pure & Applied Chemistry [Mycotoxins Symposium]; 2 have been abstracted from pure and Applied Chemistry [see FSTA (1978) 10 7C246 and 7C248]. RM

40

Mycotoxic diseases produced in mice by species of the *Aspergillus ochraceus* group.

Zimmermann, J. L.; Carlton, W. W. *Food and Cosmetics Toxicology* 15 (5) 411-418 (1977) [27 ref. En] [Dep. of Vet. Microbiol. & Path., School of Vet. Med., Purdue Univ., W. Lafayette, Indiana 47907, USA]

A description is given of mycotoxin production and mycotoxicoses produced in mice by isolates of 8 spp. of the *Aspergillus ochraceus* group (*A. sclerotiorum*, *A. alliaceus*, *A. auricomus*, *A. melleus*, *A. ochraceus*, *A. ostianus*, *A. elegans*, and *A. petrakii*). VJG

41

Toxicity of a moniliformin-producing strain of *Fusarium moniliforme* var. *subglutinans* isolated from maize.

Kriek, N. P. J.; Marasas, W. F. O.; Steyn, P. S.; Rensburg, S. J. van; Steyn M. *Food and Cosmetics Toxicology* 15 (6) 579-587 (1977) [40 ref. En] [Nat. Res. Inst. for Nutr. Diseases, SA Med. Res. Council, PO Box 70, Tygerberg 7505, South Africa]

During a study of toxic fungi in South African maize, an extremely toxic culture of *F. moniliforme* var. *subglutinans* was isolated from maize grown in the Transkei. The morphology, taxonomy, toxicity, pathology and moniliformin-producing ability of this isolate are described. The toxic culture was fed to ducklings and rats. Ducklings consuming 0.5-2.0 g of mouldy meal died within 2 h. The oral LD₅₀ of chemically pure moniliformin was 3.68 mg/kg in 7-day-old ducklings and 50 and 41.57 mg/kg, resp., in male and female black rats. VJG

42

Citrinin mycotoxicosis in the guinea-pig.

Thacker, H. L.; Carlton, W. W.; Sansing, G. A. *Food and Cosmetics Toxicology* 15 (6) 553-561 (1977) [28 ref. En] [Dep. of Vet. Microbiol. & Path., School of Vet. Med., Purdue Univ., W. Lafayette, Indiana 47907, USA]

Clinical features of citrinin toxicity in guinea-pigs given daily intragastric doses of 25, 30, 36, 40 and 50 mg/kg citrinin are described. The LD₅₀ of citrinin was 43 mg/kg/day. VJG

43

Moniliformin, a mycotoxin from *Fusarium fusarioides*.

Rabie, C. J.; Lübben, A.; Louw, A. I.; Rathbone, E. B.; Steyn, P. S.; Vleggaar, R.

Journal of Agricultural and Food Chemistry 26 (2) 375-379 (1978) [18 ref. En] [Nat. Res. Inst. for Nutr. Diseases, South African Med. Res. Council, PO Box 70, Tygerberg, 7505, South Africa]

Fusarium fusarioides was found to be highly toxic to ducklings and rats. The toxic metabolite, moniliformin (sodium or potassium salt of 1-hydroxycyclobut-1-ene-3,4-dione) was isolated as the sole toxin from *F. fusarioides*. Isolates obtained from peanuts, sorghum, millet, peaches, soil, and dried fish were all toxic to ducklings. The chronic toxicity of an isolate from millet was determined, and 10, 25, and 50% mouldy corn meal incorporated into commercial rat mash all proved toxic. The effect of different incubation temp. and periods of inoculated corn meal was investigated. Material produced at 3 different temp. (20°, 25° and 31°C) was of approx. equal toxicity, although less of the material produced at higher temp. was consumed. Analysis showed that the material incubated at 31°C contained the most moniliformin. Self-heating to a max. of 6-8°C took place at all incubation temp. 4 randomly selected isolates all produced moniliformin, in quantities of 200-840 mg/kg as estimated by TLC. Methods are described for the analyses and isolation of moniliformin from yellow corn inoculated with cultures of *F. fusarioides*. The analytical methodology involves either TLC of the extracts or purification of these on Dowex-1 (Cl-) resin; 0.2M NaCl elutes the moniliformin which is quantified by UV spectroscopy. AS

44

Food mycotoxins survey and monitoring programs. [Lecture]

Campbell, A. D.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 403-410 (1977) [7 ref. En] [FDA, Washington, DC, USA]

With the aid of examples the author discusses effective mycotoxin survey and monitoring programmes. The US aflatoxin monitoring plan for peanut processing includes import, export and manufacturing quality control. Points of testing, sampling, sample preparation and types of test, e.g. screening and multidetection chemical and confirmation tests, are discussed. [See FSTA (1978) 10 9C2971. RM]

45

Mycotoxins in foods and feeds. Their occurrence and significance. [Lecture]

Bainton, J.; Jones, B. D.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 415-424 (1977) [many ref. En] [TPI, 56/62 Gray's Inn Road, London WC1, UK]

Results from a world-wide survey on mycotoxin contaminations in foods and feeds are presented in a condensed form. Results are grouped together on geographical and commodity bases and summarized in histograms and a table. Only general indications of the current situation were obtained. [See FSTA (1978) 10 9C297.] RM

46

Kind and frequency of toxin production by cereals contaminating aspergilli and penicillia. [Lecture]

Gedek, B.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 467-475 (1977) [many ref. En] [Inst. for Med. Microbiol., Fac. of Vet. Sci., Univ. of Munich, Veterinärstrasse 13, D-8000 Munich 22, Federal Republic of Germany]

134 strains of 10 *Aspergillus* and 13 *Penicillium* spp. of grain storage flora were tested for mycotoxin and antibiotics production. Only 2 spp. of *Penicillium* produced mycotoxins, i.e. *P. cyclopium* (penicillic acid, ochratoxin A, citrinin) and *P. islandicum* (luteoskyrin). Sterigmatocystin was produced by *A. nidulans* and *A. versicolor*. None of the other spp. produced mycotoxins. The potential health hazards of grain storage moulds are briefly discussed. [See FSTA (1978) 10 9C297.] RM

47

The American Oil Chemists' Society's Smalley mycotoxin check sample program: an evaluation. [Lecture]

McKinney, J. D.; Cavanagh, G. C.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 519-529 (1977) [7 ref. En] [Ranchers Coton Oil, Box 2596, Fresno, California, USA]

Operational and statistical evaluations are presented for 2 Smalley Subcommittee series check sample programmes for mycotoxin contaminated commodities, i.e. collaborative programmes on deoiled aflatoxin-contaminated peanut meal and cottonseed meal series. Methods of analysis were restricted to those of AOAC and American Oil Chemists Society paraphrases, i.e. the AOAC 'CB' or the Best Foods methods for peanut products and the Pons procedure for cottonseed products. [See FSTA (1978) 10 9C297.] RM

48

The F.A.O. programme and mycotoxins. [Lecture]

Herz, K. O.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 545-550 (1977) [En] [Food Standards & Food Sci. Service, Food Policy & Nutr. Div., FAO, Rome, Italy]

The FAO involvement in the field of mycotoxin is reviewed. [See FSTA (1978) 10 9C297.] RM

49

[Toxicogenic power of *Aspergillus flavus* strains.] [Lecture]

Jacquet, J.; Tantaoui-Elaraki, A.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 563-574 (1977) [11 ref. Fr] [Lab. de Microbiol., UER des Sci. de la vie et du Comportement, Univ. de Caen, 14032 Caen Cedex, France]

Following a previous study on 925 *A. flavus* strains [see FSTA (1976) 8 7C310], the inheritance of toxigenicity through conidiospores was investigated. Single spore cultures showed the existence of a Gaussian distribution of toxigenicity in conidia from a colony from single spore culture of a toxigenic strain, the appearance of a small number of toxigenic conidia from a non-toxigenic strain and a large decrease in toxigenicity of toxigenic strains in mixed cultures with non-toxigenic strains. This reduction was not due to more vigorous growth of the non-toxigenic strain. Considerable variability in toxin production (aflatoxin B by *A. flavus*, B and G by *A. parasiticus*) was observed on serial testing of fractions from the same inoculum, containing the same number of spores incubated under the same conditions. [See FSTA (1978) 10 9C297.] RM

50

Toxigenic *Aspergilli* isolated from different sources in Egypt. [Lecture]

Moubasher, A. H.; El-Kady, I. A.; Shoriet, A.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 607-615 (1977) [many ref. En] [Bot. Dep., Assiut Univ., Assiut, Egypt]

45 cultures of *Aspergillus* belonging to 25 spp. and isolated from different sources in Egypt (including seeds and grain) were tested for toxicity to chicken embryos and *Bacillus megaterium*. Mycotoxins were detected by TLC. 30 isolates of 45 exhibited toxicity, 3 were high toxin producers: *A. egyptiacus*, *A. carneus* and *A. terricola*. The first 2 produced unknown toxins and *A. terricola* produced aflatoxins B₁, B₂, G₁ and G₂. Aflatoxins production by *A. terricola* is reported for the first time. [See FSTA (1978) 10 9C297.] AS

51

Mycotoxins in *Aspergillus oryzae* strains for use in the food industry as starters and enzyme producing molds. [Lecture]

Orth, R.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 617-624 (1977) [many ref. En, fr] [Federal Res. Cent. for Nutr., Engesserstrasse 20, D-7500 Karlsruhe, Federal Republic of Germany]

To prevent the occurrence of toxins in foods, German and International FAO/WHO Expert Committees on Food Additives have recommended the exclusive use of strains producing no toxic or carcinogenic metabolites as starters in food

technology. Owing to the importance of *Aspergillus oryzae* as a starter, and the discovery of a strain producing large amounts (182 mg/l.) of cyclopiazonic acid, 16 strains of *A. oryzae* were examined in vitro for production of aflatoxin, sterigmatocystin, cyclopiazonic acid and β -nitropropionic acid. None of the strains produced aflatoxin or sterigmatocystin, 8 produced cyclopiazonic acid, and 7 β -nitropropionic acid; 3 produced both mycotoxins, though on different media and under different conditions. Results suggest potential health hazards from such strains used as starters or as enzyme preparations. [From En summ.] [See FSTA (1978) 10 9C297.] RM

52

Hepato- and cardiotoxicity of xanthoascins, a new xanthocillin analogue produced by *Aspergillus candidus*. II. A preliminary electron microscopic observation of the heart and lung with intracellular myelin-like figures. [Lecture]

Ohtsubo, K.; Saito, M.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 771-779 (1977) [7 ref. En] [Inst. of Med. Sci., Univ. of Tokyo, Shirokanedai 4-6-1, Minato-ku, Tokyo 108, Japan]

Electron microscopic investigations on myocardial and pulmonary lesions in mice after administration of xanthoascins (a toxic metabolite isolated from rice grains infested with *Aspergillus candidus*) suggested that it may be a causative agent of primary myocardial diseases in man. The examination of foods for contamination with *A. candidus* and xanthoascins is urged. [See FSTA (1978) 10 9C297.] RM

53

Specific and non-specific interactions of two carcinogenic mycotoxins, luteoskyrin and rugulosin with nucleic acids. [Lecture]

Bouhet, J. C.; Pham van Chuong, P.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 811-830 (1977) [many ref. En, fr] [Service de Biochimie, CEN Saclay, BP No. 2, 91190, Gif-sur-Yvette, France]

Luteoskyrin and rugulosin are 2 hepatotoxic and carcinogenic anthraquinone-like pigments from *Penicillia* which contaminate rice and other foods. They inhibit in vivo and in vitro replication, transcription and repair of DNA of prokaryotes and eukaryotes presumably by forming chelate complexes with nucleic acids. In this paper, characterization, specificity and structure of binary polychelates (pigment-metal)_n and ternary complexes (pigment-metal-nucleic acids) are reported. [See FSTA (1978) 10 9C297.] RM

54

Action of patulin on in vitro RNA and protein synthesis. [Lecture]

Hatey, F.; Moule, Y.

Annales de la Nutrition et de l'Alimentation 31

(4/5/6) 867-870 (1977) [11 ref. Fr, en] [Inst. de Recherches Sci. sur le Cancer, 94800 Villejuif, France]

Patulin, a mycotoxin isolated from cultures of *Byssoschlamis nivea* and also detected in apples and apple juice, alters nucleic acid transcription and translation. Using cell-free systems from prokaryotic and mammalian cells, the mechanism of the mycotoxin-induced inhibition of in vitro RNA and protein syntheses was studied. [See FSTA (1978) 10 9C297.] AS

55

Short-term tests and mycotoxins. [Lecture]

Malaveille, C.; Bartsch, H.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 871-879 (1977) [many ref. En, fr] [Int. Agency for Res. on Cancer, 150 Cours Albert-Thomas, 69008 Lyon, France]

Short term tests currently used as screening techniques for potential mutagenic and carcinogenic mycotoxins are briefly discussed, i.e. mutagenesis, DNA repair, chromosomal aberrations, cell transformation, cytological alterations, and in vitro and in vivo reactions with nucleic acids. Based on recent publications and the authors' own investigations, a critical review is made of 2 major aspects of various short term tests: their predictive value in order to assess the possible carcinogenic risk; and their usefulness for investigating the mode of action of these compounds in mammals including man. [See FSTA (1978) 10 9C297.] RM

56

[Relations between chemical structure and biological properties of some eremophilane-like fungal metabolites.] [Lecture]

Moreau, S.; Moule, Y.; Bousquet, J. F.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 881-884 (1977) [5 ref. Fr, en] [Unite No. 42 de l'INSERM, Villeneuve d'Ascq, France]

A group of biologically active and chemically related eremophilane-like sesquiterpenes produced by some strains of *Penicillium roqueforti* and *Phoma exigua* var. *inoxidabilis* were studied. The relations between the chemical structure and biological properties of PR toxin and 2 derived metabolites synthesized by *P. roqueforti*, and phenomenone produced by *Phoma exigua* were examined, showing that the 3 related compounds exhibited very low inhibition on nucleic acid transcription and translation. [See FSTA (1978) 10 9C297.] RM

57

Mode of action of trichothecenes. [Lecture]

Ueno, Y.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 885-900 (1977) [41 ref. En] [Fac. of Pharmaceutical Sci., Tokyo Univ. of Sci., Ichigaya, Tokyo-162, Japan]

The toxicological and biological features of 30 kinds of trichothecene mycotoxins are summarized.

These toxins are produced by a wide range of *Fusarium*, *Mycrothecium*, *Trichoderma*, *Cephalosporium*, *Verticimonosporium* and *Stachybotris* fungi, which invade various agricultural products and cause serious human intoxication upon consumption. [See FSTA (1978) 10 9C297.] RM

58

Metabolic activation and detoxification of mycotoxins. [Lecture]

Patterson, D. S. P.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 901-910 (1977) [many ref. En] [Cent. Vet. Lab., Weybridge, Surrey, UK]

The metabolism of the aflatoxins, sterigmatocystin, ochratoxins A and B, and the trichothecene series of mycotoxins is briefly considered with emphasis on possible metabolic activation, i.e. in vivo conversion of toxins to an activated form. The main potential threat to human health is due to the appearance of aflatoxin M₁ in milk from animals fed contaminated feed. The aflatoxins, ochratoxin A and probably sterigmatocystin present residue problems when ingested by farm animals. [See FSTA (1978) 10 9C297.] RM

59

The absorption, distribution and excretion of ¹⁴C-penicillic acid by rats. [Lecture]

Park, D. L.; Dailey, R. E.; Friedman, L.; Heath, J. L.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 919-934 (1977) [15 ref. En, fr] [Office of the Associate Commissioner for Sci., FDA, Washington, DC 20204, USA]

Experiments on the metabolism of ¹⁴C-labelled penicillic acid are reported, in view of its toxic nature and occurrence in mould-infested foods (corn, rice, sorghum, barley, wheat and oats). [See FSTA (1978) 10 9C297.] RM

60

Fate and mode of action of zearalenone. [Lecture]

Ueno, Y.; Azaki, S.; Sato, N.; Ito, T.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 935-948 (1977) [5 ref. En] [Dep. of Microbiol. Chem., Fac. of Pharmaceutical Sci., Tokyo Univ. of Sci., Ichigaya, Tokyo-162, Japan]

The fate and mode of action of zearalenone, a fungal metabolite of *Gibberella zeae* (*Fusarium roseum*) associated with food-borne diseases were investigated. [See FSTA (1978) 10 9C297.] RM

61

Epidemiological features of the mycotoxicoses. [Lecture]

Akkmeteli, M. A.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 957-976 (1977) [many ref. En] [WHO, Geneva, Switzerland]

The epidemiology of some mycotoxicoses is reviewed, including stachybotryotoxicoses and alimentary toxic aleukia or fusariotoxicosis whose mycotoxic nature is not in doubt, and endemic nephropathy and primary liver-cell carcinoma which require further investigation. [See FSTA (1978) 10 9C297.] RM

62

The public health significance of mycotoxins. [Lecture]

Rutledge, A. E.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 1019-1030 (1977) [many ref. En] [Microbiol. Lab. Div. Agrimerica Inc., 1829 Stanley Street, Northbrook, Illinois 60062, USA]

A detailed review is presented of the literature on the major mycotoxin-producing fungi, and the symptoms of mycotoxicoses in man and experimental animals. Some case histories are reported. The implementation of all available techniques for reducing the contamination of foods by mycotoxins is urged. [See FSTA (1978) 10 9C297.] RM

63

Production of Penitrem A and of an unidentified toxin by *Penicillium lanoso-coeruleum* isolated from weevil-damaged pecans.

Wells, J. M.; Cole, R. J.

Phytopathology 67 (6) 779-782 (1977) [10 ref. En] [Southeastern Fruit & Tree Nut Res. Sta., USDA, Byron, Georgia 31008, USA]

Chloroform extracts of *Penicillium lanoso-coeruleum* isolated from weevil-damaged pecans and grown on shredded wheat-yeast extract-sucrose medium were toxic to 1-day-old cockerels, producing sustained tremors and convulsions prior to mortality. 2 toxic fractions were separated from chloroform extracts by sequential elution from silica gel columns with diethyl ether and acetone. Physical and chemical characteristics of purified crystals from the ether fraction correlated with those of the mycotoxin Penitrem A: an R_f value in toluene:ethyl acetate:formic acid (5:4:1, v/v) (TEF) of 0.5; UV absorption maxima in methanol at 234, 283, 294, and 300 nm; and IR absorption identical to those of Penitrem A. Methanolysis resulted in a colour reaction specific for Penitrem A. Crystals from the acetone fraction had R_f values in TEF of ≤ 0.1 , UV maxima at 317 and 245 nm, and IR maxima of 1675 and 1400 cm⁻¹. The chemical identity of the toxin in the acetone fraction is unknown. AS

64

Occurrence of patulin in fruit and vegetables. [Lecture]

Frank, H. K.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 459-465 (1977) [12 ref. En] [Federal Res. Cent. for Nutr., Engesserstrasse 20, D-75 Karlsruhe 1, Federal Republic of Germany]

Investigations of a variety of fruits and vegetables stored under different conditions showed patulin to be present in about 50% of apples and pears suffering from brown rot. Up to 1 g patulin/kg decayed apples was found 2-3 days after removal from cold store (5 months at 4°C). 90% of *Penicillium expansum*-affected apples and pears and 100% of peaches from cold stores contained patulin. Significant diffusion of patulin from decayed into healthy tissue was observed in peaches, tomatoes and pears but not in apples. Produce with natural patulin content included apples, pears, peaches, apricots, bananas, pineapples and grapes. After inoculation with *P. expansum*, *P. urticae* or *Byssosclamyces nivea*, patulin was also found in greengages, strawberries, honeydew melons, red and green paprika, tomatoes, cucumbers and carrots. The artificial infection failed in celeriac, kohlrabi, cauliflower, red cabbage, horseradish, onions, squash (zucchini), potatoes and egg plants. While some strains were able to produce the toxin at <0°C, no synthesis was observed at ≥30°C or in the absence of O₂. [See FSTA (1978) 10 9C297.] RM

65

Occurrence of *Fusarium* mycotoxins in some Hungarian corn crops and the possibilities of detoxication. [Lecture]

Lasztity, R.; Tamas, K.; Wöller, L.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 495-498 (1977) [4 ref. En] [Dep. of Biochem. & Food Tech., Tech. Univ., Budapest, Hungary]

Some results of a complex research programme on *Fusarium* contamination of cereals (maize, wheat) are reported. Under Hungarian conditions, 6 spp. produce zearalenone (F-2 toxin); toxin production is greatly influenced by temp. 2 other zearalenone derivatives F-3 and F-4 were isolated from contaminated maize. 4 of 8 zearalenone type toxins had similar structural properties and biological effects. 2 detoxification processes were developed, involving treatment with aqueous NH₃ or H₂O₂ solution followed by heating and drying. [See FSTA (1978) 10 9C297.] RM

66

[Mycotoxin production on contaminated maize by several fungal species.]

Tsuruta, O.; Sugimoto, T.; Minamisawa, M.

Report of the National Food Research Institute [Shokuryo Kenkyusho Kenkyu Hokoku] No. 32, 21-24 (1977) [16 ref. Ja, en] [Nat. Food Res. Inst., Min. of Agric. & Forestry, Tokyo, Japan]

In order to simulate more closely the natural conditions in fungus-contaminated cereals, *Aspergillus flavus* (aflatoxin producer) and *A. versicolor*, (sterigmatocystin producer) were inoculated into maize held at 28° or 18°C, and with water activities of 0.81 or 0.93. Additionally, these spp., with *Eurotium chevalieri*, *A. ochraceus* and *A. restrictus* were inoculated into maize. Contamination by several fungal spp. resulted in

remarkably low mycotoxin production, compared with cases where only 1 sp. was present. The effect was more noticeable with aflatoxin than with sterigmatocystin. [From En summ.] JRR

67

Determination of the potential for mycotoxin contamination of pasta products.

Stoloff, L.; Trucksess, M.; Anderson, P. W.; Glabe, E. F.; Aldridge, J. G.

Journal of Food Science 43 (1) 228-230 (1978) [22 ref. En] [Bureau of Foods, FDA, Washington, DC 20204, USA]

Freshly extruded macaroni and noodle doughs, dusted with flour to which spores of the toxigenic moulds *Aspergillus flavus*, *A. clavatus*, *A. versicolor*, *Penicillium urticae*, *P. cyclopium* and *P. citrinum* had been added, were held at temp.-humidity combinations (30°, 35°, 40°C and 85, 90, 95% RH) expected to simulate possible conditions in a fully loaded pasta drier shut down by a power failure. A sour odour at 95% RH suggested initial bacterial action. Mould growth was observed on all products under all conditions; the extent of growth after 5 days was directly related to both temp. and RH. Under all conditions, *A. flavus* was the dominant mould; of the mycotoxins (aflatoxins, sterigmatocystin, patulin, penicillic acid, citrinin) expected from the spp. included in the inoculum, only aflatoxins were detected. At 30°C and 95% RH, mould growth was evident after 24 h and aflatoxins could be detected after 48 h. The level of aflatoxins was low for the extent of mould growth observed, probably due to presence of the mixed culture. Because of the souring and obvious mould growth, none of the pasta could be considered useable even before aflatoxin was detected. When the aflatoxin-contaminated pasta was cooked for 10 min in boiling water, approx. 1/3 of the aflatoxin was found in the water. Based on these studies and the rarity of encountering aflatoxin in wheat, the possibility of finding aflatoxin in commercial pasta products is highly remote. IFT

68

[Excretion of ochratoxin A in rabbits' milk.]

[Lecture]

Galtier, P.; Baradat, C.; Alvinerie, M.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 911-918 (1977) [12 ref. Fr, en] [Sta. de Pharmacologie-Toxicologie de l'INRA, 180 Chemin de Tournefenille, 31300 Toulouse, France]

The excretion of ochratoxin A in rabbit milk was examined after a single intravenous administration (1, 2 or 4 mg/kg). For the highest dose (4 mg/kg), the level in milk reached 1 p.p.m. within 1 h (0.14 p.p.m. after 1 mg, 0.32 p.p.m. after 2 mg). Mammary excretion was also studied while plasma concn. of ochratoxin A was constant; the % of protein-bound toxin in plasma and milk was determined. The similarity of the theoretical and experimental ratio between mycotoxin levels in milk and plasma ultrafiltrates confirmed the

passage of the free toxin through the blood-milk barrier by non-ionic passive diffusion. The sanitary problem concerning the presence of ochratoxin A in the milk of other domestic animals is briefly discussed. [From En summ.] [See FSTA (1978) 10 9C297.] RM

69

Incidence and control of mycotoxin producing molds in domestic and imported cheeses. [Lecture] Bullerman, L. B.

Annales de la Nutrition et de l'Alimentation 31 (4/5/6) 435-446 (1977) [10 ref. En] [Dep. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, Nebraska 68583, USA]

Moulds were isolated from mouldy cheese trimmings and both non-mouldy and mouldy samples of domestic and imported retail samples of cheese. The majority of moulds found were *Penicillium* spp. A small percentage (about 4%) were spp. known to be capable of producing recognized mycotoxins (*P. cyclopium*, *P. viridicatum*, *Aspergillus flavus* and *A. ochraceus*). Most of the moulds isolated had psychrotrophic properties and were capable of growing at 5°C. Sorbates were partially effective in delaying growth, but 65-75% of the mould isolates were capable of initiating growth in the presence of 0.3% potassium sorbate within 7 days of 5°C. On the other hand, pimarinin prevented the growth of all the mould isolates at 12° and 5°C, and of 96% of the isolates at 25°C for at least 7 days. [See FSTA (1978) 10 9C297.] AS

70

[Effect of some environmental factors on excretion of P. R. toxin.] [Lecture]

Guiraud, J.; Piva, M.-T.; Crouzet, J.; Galzy, P. *Annales de la Nutrition et de l'Alimentation* 31 (4/5/6) 551-555 (1977) [3 ref. Fr, en] [Lab. de Microbiol., Sci. & Tech. des Ind. Alimentaires, Univ. des Sci. & Tech. du Languedoc, 34060 Montpellier Cedex, France]

Conditions of P. R. toxin production by 4 strains of *Penicillium roqueforti* were tested in vitro (strain NRRL 849 or CBS 221-30 and 3 industrial strains isolated from French blue cheese). Only 2 of the industrial strains produced P. R. toxin (at 6 and 3 mg/g). [See FSTA (1978) 10 9C297.] RM

71

[Roquefortine and isofumigaclavine A, alkaloids from *Penicillium roqueforti*.] [Lecture]

Polonsky, J.; Merrien, M.-A.; Scott, P. M. *Annales de la Nutrition et de l'Alimentation* 31 (4/5/6) 693-698 (1977) [many ref. En, fr] [Inst. de Chimie des Substances Naturelles, CNRS 91190 Gif-sur-Yvette, France]

Extraction of mycelium from cultures of *P. roqueforti* (strain CS 1) yielded 2 new crystalline metabolites, designated roquefortine and isofumigaclavine A. The structure of roquefortine, the major alkaloid, was established by a

combination of chemical transformations and spectroscopic studies, the structure of isofumigaclavine A by spectroscopic and X ray analysis. Roquefortine possesses neurotoxic properties when injected intraperitoneally in mice, and was detected in 16 of 16 samples of blue cheese from 7 countries at concn. of 0.06-6.8 p.p.m. (in a selected portion with visually high mould content). Analysis on visibly non-mouldy areas of 3 cheeses indicated little or no migration into these areas. Roquefortine was usually accompanied by isofumigaclavine A (<4.7 p.p.m. in selected mouldy areas). [From En summ.] [See FSTA (1978) 10 9C297.] RM

72

[Formation of mycotoxins on Tilsit cheese.]

Bildung von Mykotoxinen auf Tilsiter Käse. Engel, G.

Milchwissenschaft 33 (4) 201-203 (1978) [17 ref. De, en] [Inst. für Mikrobiol. der Bundesanstalt für Milchwissenschaft, Kiel, Federal Republic of Germany]

Mycotoxin-producing moulds (*Aspergillus flavus*, *A. parasiticus*, *A. ochraceus*, *A. versicolor*, *Penicillium citreoviride*, *P. viridicatum*, *P. urticae*, *P. patulum*, *P. claviforme*, *P. citrinum*) were grown on yeast extract-sucrose (YES) broth at pH 6.7 for 11 days at 27°C, or on sterilized Tilsit cheese for 11-20 days at 27°C or 20 days at 16°C. All cultures produced mycotoxins on YES medium. Highest mycotoxin production on Tilsit cheese was by *P. citreoviride* (10 000 and 30 000 µg citreoviridin/kg after 20 days at 16° or 27°C, resp.). Aflatoxins were formed by *A. flavus* (2000 µg B₁ and 200 µg B₂/kg) and *A. parasiticus* (15 µg B₁ and 35 µg G₁/kg) on cheese at 27°C but not at 16°C. Ochratoxin A was also produced by *A. ochraceus* at 27°C (1300 µg/kg) and not at 16°C. Penicillic acid, patulin, citrinin and sterigmatocystin were not produced by any of the moulds grown on cheese at 16° or 27°C, although they were produced in the YES medium. MEG

73

[Studies on fungal contamination of foodstuffs in Japan: fungal flora on dried small sardines marketed in Tokyo.]

Hitokoto, H.; Morozumi, S.; Wauke, T.; Sakai, S.; Zen-Yoji, H.; Benoki, M.

Annual Report of Tokyo Metropolitan Research Laboratory of Public Health 27 (1) 36-40 (1976) [26 ref. Ja, en] [Tokyo Metropolitan Res. Lab. of Public Health, 24-1 Hyakunincho 8 chome, Shinjuku-ku, Tokyo, 160 Japan]

33 batches of small dried sardines from the retail market in Tokyo were examined for mycoflora content, and toxin production by isolated fungal strains was studied. 32 of the 33 batches contained samples having measurable fungal counts in the range 5-122/g, mean 33.50/g. Average moisture content of the samples was 17.27%. The most

common contaminants (of 1140 fungal isolates) were *Aspergillus* (24.56%), *Penicillium* (20.62%), *Arthrinium* (7.72%) and *Wallemia* (7.19%). 12 fish samples had contaminants belonging to toxin-producing spp. (2-20 isolates from each sample). 6 strains of *Aspergillus versicolor* isolated from 5 samples produced sterigmatocystin, and 2 strains of *P. citrinum* isolated from 2 samples produced citrinin. 1 sample from each of the 33 batches was incubated at room temp. for 30 days either (i) untreated or (ii) in distilled water. 8 of the (i) samples and 27 of (ii) supported fungal growth. Extracts from the (ii) samples proved lethal to mice in 18 cases when injected intraperitoneally. [From En summ. and tables.] DIH

74

Amatoxin-containing mushrooms: *Amanita ocreata* and *A. phalloides* in California.

Ammirati, J. F.; Thiers, H. D.; Horgen, P. A. *Mycologia* 69 (6) 1095-1108 (1977) [20 ref. En] [N. American Poison Mushroom Res. Cent., Univ. of Toronto, Brindale Coll. Mississauga, Ontario, L5C 1C6 Canada]

Complete descriptions are given of *A. ocreata* and *A. phalloides*. *A. ocreata* is considered a distinct sp. and is reported as a dangerous poisonous mushroom containing at least 2 amatoxins, α - and β -amanitin. It is thought to be responsible for some fatal cases of mushroom poisoning in California in late winter and spring. AS

75

Degradation of rubratoxin by *Penicillium rubrum*.

Emeh, C. O.; Marth, E. H. *Mycologia* 70 (1) 196-199 (1978) [11 ref. En] [Dep. of Food Sci., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

The effect of culture conditions and type of rubratoxin on its degradation by the organism producing it was investigated. Since the common occurrence of rubratoxins and their reported synergism with aflatoxin make them an important health hazard, isolation of the degrading principle could open the door to its application for food safety. RM

76

Effect of selected pesticides on growth and citrinin production by *Penicillium citrinum*.

Draughon, F. A.; Ayres, J. C. *Journal of Food Science* 43 (2) 576-578, 583 (1978) [21 ref. En] [Dep. of Food Sci., Univ. of Georgia, Athens, Georgia 30602, USA]

The potential for inhibition of citrinin production by *P. citrinum* NRRL 5927 was investigated using the pesticides naled, dichlorvos, malathion, diazinon, pyrethrum, mevinphos, ethion, allethrin, diethyl toluamide, methoxychlor, trithion, guthion and atrazine. Citrinin was precipitated from culture media and quantitated by TLC and

spectrophotometry at 640 nm. A TLC system consisting of precoated Silica-Gel-60 plates as the solid phase and ethanol/ $\text{NH}_3/\text{H}_2\text{O}$ (80:4:16) as the liquid phase separated citrinin more satisfactorily than other TLC systems previously reported. All pesticides except the last 5 listed inhibited growth and/or citrinin production by > 40% at 100 $\mu\text{g/l}$. concn. The first 4 listed inhibited growth and/or citrinin production > 75% at concn. of 100 $\mu\text{g/l}$. IFT

77

[Determination of patulin in apple juices.] Zur Bestimmung von Patulin in Apfelsäften. Woidich, H.; Pfannhauser, W.; Blaicher, G. *Lebensmittelchemie und Gerichtliche Chemie* 32 (3) 61-63 (1978) [3 ref. De] [Forschungsinst. für Ernährungswirtschaft, Blasstrasse 29, A 1190 Vienna, Austria]

Studies on detn. of patulin in apple juice using extraction by Polzhofer's method [FSTA (1977) 9 7H1202] and analysis by high-pressure liquid chromatography on μ -Porasil, using a diisopropyl ether/tetrahydrofuran (95:5) solvent system with 0.1% added acetic acid, are described. In studies on 6 apple juice samples, 2 gave apparent patulin peaks at 280 nm; however, confirmatory examination at 254 nm failed to show the expected patulin peaks in the 2 positive juices. When patulin was added, clear peaks at 254 nm were observed. It is therefore concluded that detn. of absorption at 280 nm may lead to false positive results due to interference by a contaminant showing absorption at this wavelength; checking results by detn. of absorption at 254 nm is recommended. Recovery of patulin from a juice sample spiked with 50 μg patulin/l. was 90%. AJDW

78

Comparison of potential patulin hazard in home-made and commercial apple products.

Lindroth, S.; Niskanen, A. *Journal of Food Science* 43 (2) 446-448 (1978) [22 ref. En] [Food Res. Lab., Tech. Res. Cent. of Finland, Biologinkuja 1, SF-02150 Espoo 15, Finland]

TLC methods were used for the detn. of patulin in 166 samples of apple products. A new 2-dimensional method, using benzene/methanol/acetic acid as the 1st developing solution and toluene/ethyl acetate/formic acid as the 2nd, was developed for quantification of patulin in apple juice concentrates. The patulin concn. in other samples were assayed using the conventional AOAC method. Of 64 lots of apple juice concentrate imported into Finland (0.9 million kg), 13 lots (0.2 million kg) contained patulin, at concn. of 50-690 $\mu\text{g/l}$. Of 14 apple flavour lots studied (0.2 million kg), patulin was found in 3 (0.1 million kg), at concn. of 6-1770 $\mu\text{g/l}$. Of 20 samples of home-made apple juice examined, 8 were found to contain patulin, with concn. between 30 and 16 400 $\mu\text{g/l}$. The frequency of occurrence of patulin in

commercial and home-made apple juices was 20 and 40% resp. In home-made apple jam which had become mouldy during storage, patulin was found to diffuse to all levels of the jam. 10 samples of apples spontaneously affected by mould in the laboratory contained patulin, indicating the abundance of patulin-producing fungal strains. On the basis of the results obtained the patulin risk in home-made apple products appears to be greater than in commercial apple products. IFT

79

Differences in the chemical constituents of *Mangifera indica*, infected with *Aspergillus niger* and *Fusarium moniliformae*.

Ghosal, S.; Biswas, K.; Chattopadhyay, B. K. *Phytochemistry* 17 (4) 689-694 (1978) [31 ref. En] [Pharmaceutical Chem. Res. Lab., Dep. of Pharmaceutics, Banaras Hindu Univ., Varanasi-5, India]

The isolation and characterization of the chemical constituents of different parts of *Mangifera indica*, sound and infected with 2 pathogenic fungi, viz. *Aspergillus niger* and *Fusarium moniliformae*, are described. Natural occurrence of 2 polyketideshikimate-derived depsides is reported for the first time. Additionally, a number of xanthenes, flavonoids, triterpenes and amino acids, not encountered before in this species, are reported. The co-occurrence of mangiferin, 1,3,6,7-tetra- and 1,3,5,6,7-pentaoxygenated xanthenes and the quantitative variation of the latter 2 compounds with the growing of the plant and during the fungal infection are biochemically significant. The protector role of the flavonoids and other C₁₅ metabolites to *M. indica* from the ingress of the fungal hyphae is indicated. The 2 pathogenic fungi secreted a number of mycotoxins in different parts of the host species during its vegetation and flowering periods. During the elaboration of these toxic metabolites, the host-pathogen interaction played an important role. Evidence is presented for *A. niger* as a mycotoxin producing fungus. AS

80

Fungi, especially *Gibberella zeae*, and zearalenone occurrence in wheat.

Hesseltine, C. W.; Rogers, R. F.; Shotwell, O. *Mycologia* 70 (1) 14-18 (1978) [4 ref. En] [N. Regional Res. Cent., USDA, Peoria, Illinois 61604, USA]

102 samples of wheat (50 kernels/sample) marketed in 1975 were studied for fungal infection and presence of mycotoxins. Of 19 zearalenone-positive samples, 6-60% of surface-sterilized kernels were infected with *G. zeae*. Conc. of zearalenone ranged from 364 to 11 054 parts/billion (in a sample with 36% infection), but was mostly between 1000 and 3000. *G. zeae* was not detected in 35 samples. Of 24 samples with > 10% infection, 17 contained zearalenone, and 7 were negative. Of 43 samples with ≤ 10% *G. zeae* infection, only 2 were zearalenone positive, with low levels (< 1000 parts/billion). *Aspergillus flavus* was detected in 53

samples with an infection rate of 2-46%, but no aflatoxin was found. *Alternaria* spp. were found in 100 samples, and *Penicillium* spp. in 20 samples (2-16% infection). RM

81

Mycotoxicological investigations on *Zambian* maize.

Marasas, W. F. O.; Kriek, N. P. J.; Steyn, M.; Rensburg, S. J. van; Schalkwyk, D. J. van *Food and Cosmetics Toxicology* 16 (1) 39-45 (1978) [33 ref. En] [Nat. Res. Inst. for Nutr. Diseases & Inst. for Biostatistics, S. African Med. Res. Council, PO Box 70, Tygerberg 7505, S. Africa]

In Zambia there is a statutory requirement that visually diseased kernels should not constitute > 2% of maize intended for human consumption. 4 samples of *Zambian* maize containing 1.8, 5.4, 13.0 and 20.3% visually diseased kernels were subjected to mycological and chemical analyses and to toxicity trials in ducklings and rats. The dominant fungi isolated from surface-sterilized kernels were *Fusarium moniliforme* Sheldon and *Diplodia macrospora* Earle and the most prevalent fungus isolated from prepared maize meals was *F. moniliforme*. The fungal invasion level of both kernels and meal was significantly lower for the 1.8% diseased sample than for the other 3. Protein and essential amino acid content tended to increase as the level of diseased kernels increased. Of 7 pure cultures of fungi isolated from the maize samples, 5, including *F. moniliforme* and *D. macrospora*, were acutely toxic to ducklings and rats. It is recommended that the 2% max. level of visually diseased kernels acceptable in *Zambian* maize for human consumption should be maintained. VJG

82

Trichothecene mycotoxins from *Fusarium sulphureum*.

Steyn, P. S.; Vleggaar, R.; Rabie, C. J.; Kriek, N. P. J.; Harington, J. S. *Phytochemistry* 17 (5) 949-951 (1978) [13 ref. En] [Nat. Chem. Res. Lab., Council for Sci. & Ind. Res., Pretoria, S. Africa]

4 mycotoxins isolated from moulded maize cultures of *Fusarium sulphureum* have been characterized as 3α, 4β, 15-triacetoxy-12,13-epoxytrichothec-9-ene, 4β, 15-diacetoxy-3α-hydroxy-12,13-epoxytrichothec-9-ene, 15-acetoxy-3α,4β-dihydroxy-12,13-epoxytrichothec-9-ene and 4β-acetoxy-3α,15-dihydroxy-12,13-epoxytrichothec-9-ene. AS

83

High incidence of hepatic tumours in rats fed mouldy rice contaminated with *Aspergillus versicolor* containing sterigmatocystin.

Ohtsubo, K.; Saito, M.; Kimura, H. *Food and Cosmetics Toxicology* 16 (2) 143-149 (1978) [27 ref. En] [Dep. of Carcinogenesis & Cancer Susceptibility, Inst. of Med. Sci., Univ. of

Tokyo, Shirokanedai, Minato-ku, Tokyo 108, Japan]

Rats were fed on a diet into which mouldy rice was mixed to provide a dietary level of 5 or 10 p.p.m. sterigmatocystin, the lowest level of this toxin yet investigated and a level that may occur under natural conditions. This study showed that these rice culture diets caused a high frequency of hepatic tumours in rats - 92.3 and 84.6% with 10 and 5 p.p.m. resp. It may be concluded that sterigmatocystin is a more potent carcinogen than was previously thought, having nearly the same degree of carcinogenicity as aflatoxin B₁. Although it has only been detected in obviously damaged rice, a more extensive survey of the presence of sterigmatocystin and related compounds in staple foods, such as rice, is recommended. VJG

84

Production of penicillic acid and patulin by an atypical *Penicillium roqueforti* isolate. Olivigni, F. J.; Bullerman, L. B. *Applied and Environmental Microbiology* 35 (2) 435-438 (1978) [20 ref. En] [Dep. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, Nebraska 68583, USA]

Simultaneous production of penicillic acid and patulin by an atypical strain of *Penicillium roqueforti* isolated from Cheddar cheese is reported. Mycotoxin production was confirmed by TLC and GLC and by UV, IR and MS analyses. Culture extracts were toxic to *Bacillus megaterium* and chicken embryos. Commercial strains of *P. roqueforti* used in production of blue-veined cheeses were shown not to produce penicillic acid and patulin. AS

85

[TLC confirmatory reactions for detection of patulin in apple juice.]

Dünnschichtchromatographische Bestätigungsreaktionen für den Nachweis von Patulin in Apfelsaft. Meyer, R. A.

Nahrung 22 (1) 75-78 (1978) [16 ref. De. en. ru] [Bezirks-Hygieneinspektion & -Inst., Dresden, German Democratic Republic]

A method for detn. of patulin in apple juice is described based on extraction with ethyl acetate, purification on a silica gel column, and TLC separation on a silica gel G or GF₂₅₄₊₃₆₆ plate, using toluene/ethyl acetate/85% formic acid (50:40:10 v/v) or chloroform/acetone (68:32) solvent systems. After evaporation of the solvent, the plate is treated with NH₃ vapour for 10 min, then sprayed with a 2% aqueous phenylhydrazine chloride solution and heated for 10 min at 110°C. Patulin gives a yellow fleck; detection limit is 100 ng. Alternatively, after evaporation of the solvent, the plate is held for 10 min in a Cl₂ atm, then sprayed with a solution of 50 mg dinitrophenylhydrazine in 5 ml ethanol + 5 ml 20% H₂SO₄. Patulin gives yellow flecks after heating at 110°C for 5 min. Detection limit is 100 ng patulin. For confirmation of patulin, the yellow flecks are

scraped off the chromatogram, applied to the start-line of a new TLC plate (silica gel G for the phenylhydrazone derivatives, GF₂₅₄₊₃₆₆ for the 2,4-dinitrophenylhydrazones) and re-chromatographed, using the previously-mentioned solvent systems. AJDW

86

Effect of light on aflatoxins, anthraquinones, and sclerotia in *Aspergillus flavus* and *A. parasiticus*. Bennett, J. W.; Fernholz, F. A.; Lee, L. S. *Mycologia* 70 (1) 104-116 (1978) [32 ref. En] [Tulane Univ., New Orleans, Louisiana 70118, USA]

The effects of continuous light and continuous darkness on aflatoxin and anthraquinone formation by wild, variant and mutant strains of *A. flavus* and *A. parasiticus* were studied. Results of in vitro experiments showed no light inhibition on production of these secondary metabolites, but continuous white light inhibited the formation of sclerotia in 10 of 13 strains. Since the sclerotia of aflatoxigenic fungi contain a potent neurological agent (tremorgen), dark-grown cultures of these moulds may present a double toxigenic threat. RM

87

High-pressure liquid chromatography of the mycotoxins, rubratoxins A and B, and its application to the analysis of urine and plasma for rubratoxin B.

Unger, P. D.; Hayes, A. W. *Journal of Chromatography* 153 (1) 115-126 (1978) [18 ref. En] [Dep. of Pharmacology & Toxicology, Univ. of Mississippi Med. Cent., Jackson, Mississippi 39216, USA]

The rubratoxins are toxic metabolites produced by *Penicillium rubrum* and *P. purpurogenum* on food and feedstuffs. Rubratoxin B is hepatotoxic, mutagenic and teratogenic. Rubratoxins A and B were resolved as sharp peaks in the order A-B by reversed-phase high-pressure liquid chromatography on a small-particle (10 µm) column in 3 min by an acetonitrile/water/ethyl acetate elution solvent (11:9:9:3), with detection by UV absorbance at 254 nm. The relationship between peak height and quantity injected was linear over a range of 0.25-5 µg for A and 0.05-5 µg for B. Retention time and peak height and peak area were highly reproducible for both toxins. Detection was very sensitive, i.e. 3-5 ng rubratoxin B and 15-20 ng rubratoxin A. Good recovery of rubratoxin B was obtained from spiked biological samples. AS

88

PR toxin production in different *Penicillium roqueforti* strains.

Wei, R.-D.; Liu, G.-X. *Applied and Environmental Microbiology* 35 (4) 797-799 (1978) [4 ref. En] [Dep. of Biochem., Nat. Yang-ming Med. Coll., Taipei, Taiwan]

89

[Detection and effects of mycotoxins.]

Untersuchungen zum Nachweis und zur Wirkung von Mykotoxinen. [Review]

Norpoth, K.; Bösenberg, H.

Berichte über Landwirtschaft 55 (4) 835-847

(1977, publ. 1978) [70 ref. De, en, fr] [Inst. für

Staublungenforschung & Arbeitsmed., Univ.

Münster, Westring 10, 4400 Münster, Federal

Republic of Germany]

Methods of mycotoxin analysis, and the toxic effects of mycotoxins are reviewed with particular reference to aflatoxins. Aspects covered include TLC analysis methods; separation of aflatoxins and their derivatives using high-pressure liquid chromatography (sensitivities of 0.05 ng/ml are possible using fluorescence detection); and MS techniques. Bioassay and radioimmunoassay methods are briefly referred to. Toxicity of aflatoxins, and formation of toxic metabolites in animal tissues are also considered. DIH

90

A convenient thin layer chromatographic method for the detection of cyclochlorotine and simatoxin, toxins from *Penicillium islandicum* Sopp.

Ghosh, A. C.; Manmade, A.; Bousquet, A.;

Townsend, J. M.; Demain, A. L.

Experientia 34 (6) 819-820 (1978) [18 ref. En]

[SISA Inc., & Sheehan Inst. for Res., Inc.,

Cambridge, Massachusetts 02138, USA]

A rapid, convenient method is described for detection of toxins produced by *Penicillium islandicum* Sopp, a common storage mould of rice, peanuts and soybeans. Moulded grain is extracted with methylene chloride, residual grain is extracted with water, the aqueous extract is treated with charcoal and filtered, and the charcoal is extracted with acetone/water (1:1). After filtration the charcoal is extracted with n-butanol, the solution is extracted with 1M phosphate buffer, pH 7.0, and the extracted n-butanol solution is chromatographed on a Sephadex LH 20 column, eluting with water/methanol (1:1). Fractions are collected and examined by TLC on silica gel plates developed in n-butanol/acetic acid/water (4:1:2). Toxins are visualized by exposure to Cl_2 followed by o-tolidine reagent spray. Laboratory-moulded grains gave a yellow spot corresponding to cyclochlorotine (a known toxic metabolite of *P. islandicum*), and a further yellow spot on the TLC plate was identified as a hitherto unknown toxin, simatoxin. DIH

91

Production of luteoskyrin and isolation of a new metabolite, pibasterol, from *Penicillium islandicum* Sopp.

Ghosh, A. C.; Manmade, A.; Kobbe, B.;

Townsend, J. M.; Demain, A. L.

Applied and Environmental Microbiology 35 (3) 563-566 (1978) [15 ref. En] [SISA, Inc.,

Cambridge, Massachusetts 02138, USA]

Production of luteoskyrin, a hepatotoxin synthesized by the common storage mould *P. islandicum* Sopp., was studied with various fermentation methods. Best results were obtained in static fermentations on glutinous rice at 30°C. The isolated yield of pure luteoskyrin was approx. 400 mg/kg rice. Also produced were skyrin, islandicin, iridoskyrin, rubroskyrin, chrysophanol, mannitol and erythritol. A new metabolite, pibasterol, was also isolated. AS

92

Spectroanalytical parameters of fungal metabolites. V. Rubratoxin B.

Neely, W. C.; Siraj, M. Y.; Smith, L. B.; Hayes, A. W.

Journal of the Association of Official Analytical Chemists 61 (3) 601-604 (1978) [21 ref. En]

[Dep. of Chem., Auburn Univ., Auburn, Alabama 36830, USA]

See FSTA (1973) 5 3C80 for part III.

93

Spectral behavior of ochratoxin A in different solvents.

Golinski, P.; Chelkowski, J.

Journal of the Association of Official Analytical Chemists 61 (3) 586-589 (1978) [10 ref. En]

[Acad. of Agric., Inst. of Chem., ul. Wojska Polskiego 75, 60-625 Poznan, Poland]

The spectral behaviour of ochratoxin A in solvents of different polarity was investigated. A red shift of absorption max. from 325 to 375 nm in several solvents was observed as well as a red shift of fluorescence max. Molar extinction coeff. and efficiencies of fluorescence were dependent on solvent polarity. AS

94

[Use of cell cultures and hen embryos for evaluating the toxicity of *Aspergillus flavus* isolated from food products.]

Lozbin, L. I.; Marova, M. S.; Makedon, I. Yu.

Gigiena i Sanitariya No. 4, 79-82 (1978) [6 ref.

Ru] [Kievskii Nauchno-issled. Inst. Gigeny Pitaniya, Kiev, USSR]

95

[Analysis of fusarium toxins (Trichothecene toxins).] Beitrag zur Analytik der Fusarium-Toxine (Trichothecen-Toxine).

Siegfried, R.; Frank, H. K.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 166 (6) 363-367 (1978) [25 ref. De, en] [Bundesforschungsanstalt für Ernährung, Engesserstrasse 20, D-7500 Karlsruhe 1, Federal Republic of Germany]

Isolation of toxins from plant material (e.g. maize or potato) contaminated by *Fusarium* spp. is described. Initial extraction is with ethyl acetate, the extract is washed with water and concentrated by evaporation, and dissolved in methanol/water

(4:1, v/v) and defatted with n-hexane. The methanolic solution is diluted with water and extracted with chloroform/ethyl acetate (1:1, v/v). The chloroform-containing phase is dried and concentrated. A TLC technique for identifying fusarium toxins is described, using silica gel plates developed in benzene/acetone/ethyl acetate (10 + 3 + 3, v/v/v). Spots are visualized by spraying with 20% H_2SO_4 then heating at 100°C. A published biotest of toxicity of compounds isolated by TLC uses larvae of *Artemia Salina*. The test is improved by filtering the solutions obtained after elution from TLC plates; silica gel is toxic to *Artemia salina*. Gas chromatographic separation of toxins is described. Since > 30 fusarium toxins are known, comparison with standards is difficult, and groups of fusarium toxins are tabulated, which after hydrolysis can be made to yield the same derivative; about 8 derivatives must then be determined. DIH

96

Ochratoxin A mycotoxicosis in the guinea-pig.

Thacker, H. L.; Carlton, W. W.

Food and Cosmetics Toxicology 15 (6) 563-574 (1977) [45 ref. En] [Dep. of Vet. Microbiol. & Path., School of Vet. Med., Purdue Univ., W. Lafayette, Indiana 47907, USA]

The clinical, clinico-pathological and pathological features of ochratoxin A toxicosis in young guinea-pigs are described. The dose of 5.6 mg/kg was essentially a no-effect dose. The 14-day LD_{50} was 9.1 mg/kg for males and 8.1 mg/kg for females. VJG

97

Isolation and purification of moniliformin.

Steyn, M.; Thiel, P. G.; Schalkwyk, G. C. van

Journal of the Association of Official Analytical Chemists 61 (3) 578-580 (1978) [15 ref. En] [Nat. Res. Inst. for Nutr. Diseases, South African Med. Res. Council, PO Box 70, Tygerberg 7505, South Africa]

A bulk purification procedure is described for moniliformin, a mycotoxin produced by *Fusarium moniliforme*. The method involves methanol extraction of suitably moulded maize, aqueous extraction of the methanol-free residue, ion exchange chromatography with an NaCl concn. gradient, desalination, and crystallization. A pKa value of 1.70 as well as molar absorptivities of 19100 ($\lambda(H_2O)_{max}$ 229 nm), 5600 ($\lambda(H_2O)_{max}$ 260 nm), and 4700 ($\lambda(methanol)_{max}$ 260 nm) l./mol cm are reported for moniliformin. AS

98

Colorimetric determination of terreic acid produced by *Aspergillus terreus*.

Subramanian, T.; Mohan Namasivayam, K.;

Shanmugasundaram, E. R. B.

Journal of the Association of Official Analytical Chemists 61 (3) 581-583 (1978) [11 ref. En] [Dep. of Biochem., Univ. of Madras, Guindy Campus, Madras 600 025, India]

2 methods were developed for determining terreic acid, which is a mycotoxin produced by *A. terreus*, a common food contaminant. The organism was grown independently in synthetic minimal medium, bread, and rice. After 15 days of growth, the toxin was extracted with ethyl acetate, cleaned up by TLC, and determined colorimetrically, using Folin's reagent or 2,4-dinitrophenylhydrazine. The production of terreic acid was greater on bread than on rice or minimal medium. Recoveries of 200-400 μ g added terreic acid/100 g bread and rice ranged from 62 to 98%. The lower limit of detection was 200 μ g/100 g. AS

99

Rapid thin layer chromatographic method for determining aflatoxin B₁, ochratoxin A, and zearalenone in corn.

Balzer, I.; Bogdanic, C.; Pepeljnjak, S.

Journal of the Association of Official Analytical Chemists 61 (3) 584-585 (1978) [9 ref. En] [Fac. of Agric., Univ. of Zagreb, Zagreb, Yugoslavia]

A multimycotoxin TLC method is described for the analysis of corn. Aflatoxins are extracted from the samples with acetonitrile-water, and sodium bicarbonate is added to separate the acidic ochratoxin from zearalenone and aflatoxin B₁. After chloroform extraction, 1N NaOH is added to separate zearalenone and aflatoxin B₁. The separated mycotoxins are spotted on TLC plates, which are then examined under UV light. The following recoveries (%) were obtained for corn samples: aflatoxin B₁ 71, ochratoxin A 87, and zearalenone 85. The limits of detection for the respective mycotoxins were 2, 40 and 200 ng/g. AS

100

[Introduction to mycotoxin problems.] Einführung in die Mykotoxin-Problematik. [Review] Kiermeier, F.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 167 (2) 115-127 (1978) [106 ref. De, en] [Chem.-Physikalisches Inst., Süddeutsche Versuchs- & Forschungsanstalt für Milchwirtschaft, D-8050 Freising-Weihenstephan, Federal Republic of Germany]

Aspects covered in this review include: definition of mycotoxins; toxicity; foods in which mycotoxins occur; mycotoxins and toxigenic fungi in foods; factors influencing mycotoxin formation; and problems with sampling of foods for detn. of mycotoxins with reference to uneven distribution of mycotoxins, instability of mycotoxins, sample size, sample subdivision, and sampling of packaged foods. AJDW

101

Patulin production by *Penicillium roqueforti* Thom from grape.

Harwig, J.; Blanchfield, B. J.; Scott, P. M.

Canadian Institute of Food Science and Technology

Journal 11 (3) 149-151 (1978) [25 ref. En, fr]
[Health Protection Branch, Tunney's Pasture,
Ottawa, Ontario K1A 0L2, Canada]

7 isolates of *Penicillium roqueforti* from mouldy grapes were examined for toxin production. In 5-ml cultures, all produced patulin, in amounts varying from 20 to 1267 µg/culture, after 9 days growth at 25°C in 2% yeast extract-15% sucrose medium. 6 cheese isolates of *P. roqueforti* did not produce patulin under these conditions. The physico-chemical properties of crystalline patulin from 1 grape isolate corresponded to those of authentic patulin. Gentisyl alcohol and 1,4-hydroquinone were also identified in extracts of this isolate. AS

102

Mycotoxins in food. Proceedings of the 2nd International Symposium IUPAC and PAN 23-25 July, 1974, Pulawy, Poland. [Conference proceedings]

International Union of Pure & Applied Chemistry; Poland, Polish Academy of Sciences

Zeszyty Problemowe Postepow Nauk Rolniczych No. 189, 1-293 (1977) [many ref. En, pl, ru]

Papers presented at the symposium include Mycotoxins in foods, by A. D. Campbell (abstr. only, p. 19, En, pl, ru); Experimental porcine nephropathy induced by ochratoxin A contaminated feed. Changes of renal function and structure, by P. Krogh, N. H. Axelsen, F. Elling, N. Gyrð-Hansen, B. Hald, J. Hyldgaard-Jensen, A. E. Larsen, A. Madsen, H. P. Mortensen, T. Møller, O. K. Petersen, U. Ravnskov, M. Rostgaard & O. Aalund (abstr. only, pp. 201-202, En, pl, ru); and Detection method for sterigmatocystin, ochratoxins and aflatoxin B₁ (work in progress), by K. Lemieszek (pp. 267-268, 1 ref., En, pl, ru). A further 27 papers are abstracted separately and are in FSTA in the author index under International Union of Pure & Applied Chemistry [2nd Mycotoxins Symposium]. DIH

103

Use of high performance liquid chromatography combined with fluorescence detection for the identification and estimation of aflatoxins and ochratoxin in food.

Hunt, D. C.; Bourdon, A. T.; Wild, P. J.; Crosby, N. T.

Journal of the Science of Food and Agriculture 29 (3) 234-238 (1978) [8 ref. En] [Dep. of Ind., Lab. of the Gov. Chem., Cornwall House, Stamford Street, London SE1 9NQ, UK]

A method was developed for the separation, identification and estimation of 6 mycotoxins in foods at the µg/kg level. The food is extracted by using aqueous acetonitrile and the extract is then washed with 2,2,4-trimethylpentane and any mycotoxins re-extracted into chloroform. The extract is then purified using grooved TLC plates coated with silica gel. After chromatography, any fluorescent bands are removed and examined by high performance liquid chromatography using a fluorescence detector. The method was tested using

a range of foods [baked beans, nuts, breakfast cereal], including total diet samples. Recoveries at twice the detection limit [µg/kg] aflatoxins B₁, B₂, 2.5; aflatoxins G₁, G₂, M₁, 0.3-0.6; and ochratoxin A, 12.5] varied from 40 to 95%. AS

104

Studies on toxifertilin, a new mycotoxin. I. Production, isolation, physico-chemical characteristics and biological properties. Yagishita, K.; Jinnouchi, H.; Yamamoto, H. *Bulletin of the College of Agriculture and Veterinary Medicine, Nihon University [Nihon Daigaku Nojoigakubu Gakujutsu Kenkyu Hokoku]* No. 35, 1-13 (1978) [9 ref. En, ja] [Lab. Nutr. & Physiol. Chem., Coll. Agric. & Vet. Med., Nihon Univ., 34-1, Shimouma 3, Setagaya-ku Tokyo 154, Japan]

Studies on toxifertilin, a newly identified mycotoxin formed by *Streptomyces toxifertilis* (which grows well on rice and potatoes), are described. Aspects covered include conditions for formation of toxifertilin, isolation and extraction methods, physicochemical properties, antibacterial activity, and mammalian toxicity. The possible significance of toxifertilin for food hygiene and public health is briefly considered. [See also following abstr.] AJDW

105

Studies on toxifertilin, a new mycotoxin. II. Production of toxifertilin in solid media. Jinnouchi, H.; Yamamoto, H.; Yagishita, K. *Bulletin of the College of Agriculture and Veterinary Medicine, Nihon University [Nihon Daigaku Nojoigakubu Gakujutsu Kenkyu Hokoku]* No. 35, 14-20 (1978) [9 ref. En, ja] [Lab. Nutr. & Physiol. Chem., Coll. Agric. & Vet. Med., Nihon Univ., 34-1, Shimouma 3, Setagaya-ku Tokyo 154, Japan]

See also preceding and following abstr.

106

Studies on toxifertilin, a new mycotoxin. III. On *Streptomyces* new species producing toxifertilin. Yagishita, K.; Jinnouchi, H.; Yamamoto, H.; Takahashi, N.; Tanimura, M. *Bulletin of the College of Agriculture and Veterinary Medicine, Nihon University [Nihon Daigaku Nojoigakubu Gakujutsu Kenkyu Hokoku]* No. 35, 21-27 (1978) [10 ref. En, ja] [Lab. Nutr. & Physiol. Chem., Coll. Agric. & Vet. Med., Nihon Univ., 34-1, Shimouma 3, Setagaya-ku Tokyo 154, Japan]

See also preceding abstr.

107

Use of high performance liquid chromatography [HPLC] for the identification and estimation of zearalenone, patulin and penicillic acid in food. Hunt, D. C.; Bourdon, A. T.; Crosby, N. T. *Journal of the Science of Food and Agriculture* 29

(3) 239-244 (1978) [10 ref. En] [Dep. of Ind., Lab. of the Gov. Chem., Cornwall House, Stamford Street, London SE1 9NQ, UK]

A method is described for the estimation of 3 UV-absorbent mycotoxins in foods by using semi-preparative and analytical HPLC columns. The foodstuff is extracted using aqueous acetonitrile, and fatty matter is removed from the extract by partition into 2,2,4-trimethylpentane. Mycotoxins present in the fat-free extract are then back extracted into chloroform and separated into 2 fractions on a silica gel column using diethyl ether and then chloroform/methanol. Further purification on a semi-preparative alumina column is described prior to measurement of mycotoxin content on analytical HPLC columns. Recoveries of zearalenone, patulin and penicillic acid added at 2-4 × the detection limit to samples of meat, dairy products and cereals ranged from 50 to 100%. An interfering peak prevented measurement of low levels of zearalenone in baked beans and dairy products. AS

108

Organization and results of mycotoxin control in the GDR. [Lecture]

Thurm, V.

Zeszyty Problemowe Postepow Nauk Rolniczych

No. 189, 149-154 (1977) [33 ref. En, pl, ru]

[Chem. Dep., Hygiene Inst. Wernigerode, Burgstrasse 37, DDR 37 Wernigerode, German Democratic Republic]

The examination of foods for mycotoxins in the German Democratic Republic is discussed, with particular reference to aflatoxins in peanuts, and resulting aflatoxins M₁ and M₂ in milk from cows fed contaminated peanut meal. Sampling procedures for imported peanuts are described and the official methods for screening for aflatoxin content and quantitative detn. of aflatoxins in peanuts are summarized. Contaminated peanuts are used for producing peanut oil. 23% of peanut samples analysed have contained aflatoxins (mainly B₁ and G₁). It is recommended that sampling be extended to cover other foods and other mycotoxins, and that animal feed should be sampled as a preventive measure against contamination of milk and meat. [See FSTA (1978) 10 12C454.] DIH

109

The chemistry of some mycotoxins. [Lecture]

Steyn, P. S.; Vleggaar, R.; Seegers, J. C.

Zeszyty Problemowe Postepow Nauk Rolniczych

No. 189, 163-168 (1977) [14 ref. En, pl, ru]

[Nat. Chem. Res. Lab., PO Box 395, Pretoria 0001, South Africa]

Structural aspects of an aflatoxin B₁ metabolite, 5-hydroxy-aflatoxin B₁, and austocystins A, B, C and D are discussed. Austocystins are more toxic than sterigmatocystin, and possible structure-function relationships are discussed. The toxicity of several synthesized ochratoxin A analogues was

assessed in a kidney epithelial cell culture system: none of these ochratoxin A analogues was found to be produced by *Aspergillus ochraceus* grown on rice. [See FSTA (1978) 10 12C454.] DIH

110

Analysis for sterigmatocystin. [Lecture]

Steyn, P. S.

Zeszyty Problemowe Postepow Nauk Rolniczych

No. 189, 233-241 (1977) [46 ref. En, pl, ru]

[Nat. Chem. Res. Lab., PO Box 395, Pretoria 0001, South Africa]

The chemical properties, occurrence and toxicity of sterigmatocystin are reviewed, as are chemical methods of analysis, which are much more rapid than biological methods and hence suitable for routine screening. Aspects covered include suitable extraction procedures, TLC systems, chromogenic reagents, GLC, MS (the mass spectrum is illustrated), and NMR (chemical shifts in NMR spectra of sterigmatocystin and 3 derivatives are tabulated). [See FSTA (1978) 10 12C454.] DIH

111

Problems concerning mycotoxin determination.

[Lecture]

Fritz, W.; Engst, R.; Krug, G.

Zeszyty Problemowe Postepow Nauk Rolniczych

No. 189, 285-290 (1977) [5 ref. En, pl, ru]

[Cent. Inst. for Nutr. of Acad. of Sci. of GDR, 1505 Potsdam-Rehbrücke, German Democratic Republic]

Methods used in the German Democratic Republic for detecting specific aflatoxins in routine inspection of foods are discussed. Some mouldy foods (cherries, strawberry jam, grapes and baby foods) contained fluorescent compounds which were not aflatoxins, but absence of aflatoxins was only demonstrated by UV or fluorescence spectroscopy. The reagent 'Echtblausalz-B' was found useful for spraying TLC plates, as specific colour compounds are formed with aflatoxins. Elution of fluorescent spots from TLC plates followed by UV spectroscopy can detect 0.01 µg aflatoxin/kg. Fluorescence spectrophotometers can record spectra directly from TLC plates, and direct fluorodensitometric quantitation is possible. Recovery of aflatoxin B₁ is 89%, s.d. 6.4% with a variation coeff. of 7.3. Similar methods can be applied to ochratoxins. Aflatoxin contents of oranges and peanuts determined during routine investigation of spontaneously moulded foods are tabulated. [See FSTA (1978) 10 12C454.] DIH

112

Occurrence and estimation of sterigmatocystin-producing strains of *Aspergillus versicolor* in foodstuffs. [Lecture]

Orth, R.

Zeszyty Problemowe Postepow Nauk Rolniczych

No. 189, 25-33 (1977) [33 ref. En, pl, ru] [Fed.

Res. Cent. for Food Preservation, Engesserstrasse 20, D-75 Karlsruhe, Federal Republic of Germany]

A. versicolor isolates obtained from a number of German foods were screened for sterigmatocystin production, and environmental factors influencing mould growth and toxin production were investigated. Of 150 strains tested, isolated mainly from meat products and spices, 90 strains produced sterigmatocystin. Toxicogenicity depended on source of isolate: 100% of strains isolated from white pepper were toxigenic, whereas 29% of strains from meat and sausage products were toxigenic. Optimum conditions for toxin production were 25-30°C at pH 8. The organism cannot grow on low water activity substrates, e.g. jams, and will not produce toxin on fresh fruits, but most other foods under laboratory conditions will support growth and toxin production. General toxicological aspects of *A. versicolor* contamination of foods are discussed. [See FSTA (1978) 10 12C454.] DIH

113

Spontaneous occurrence of ochratoxin residues in kidneys of fattening pigs.

Rutqvist, L.; Björklund, N.-E.; Hult, K.; Gatenbeck, S.

Zentralblatt für Veterinärmedizin, A 24 (5) 402-408 (1977) [39 ref. En, de, fr, es] [Nat. Vet. Inst., S-104 05 Stockholm, Sweden]

Ochratoxin A levels of ≥ 2 parts/billion (p.p.b.) were found in 32 of 129 kidneys (25%) from normally slaughtered swine. The kidneys were selected at 4 slaughterhouses (situated in the S, SE, SW, and N parts of Sweden) and were sent for examination because on macroscopic inspection they had appeared to deviate in some respect from normal kidneys. Ochratoxin A was found in kidneys from all the slaughterhouses. Levels of ≥ 5 p.p.b. were found in 7 kidneys (5, 7, 10, 14, 30, 42 and 104 p.p.b.). Most of these kidneys showed histological changes corresponding to those that occur in ochratoxicosis in swine. AS

114

High pressure liquid chromatographic determination of xanthomegnin in corn.

Stack, M. E.; Brown, N. L.; Eppley, R. M.

Journal of the Association of Official Analytical Chemists 61 (3) 590-592 (1978) [17 ref. En] [FDA, Div. of Chem. & Physics, Washington, DC 20204, USA]

A method is described for the detection and quantitative analysis of xanthomegnin in corn samples. Initial extraction with chloroform in the presence of 0.5M H_3PO_4 is followed by additional purification using silica gel column chromatography. A high pressure liquid chromatograph equipped with a microparticle silica gel column and a 405 nm absorbance detector is used for detection and quantitation of the xanthomegnin. The identity of xanthomegnin is confirmed by TLC on silica gel plates developed with benzene/methanol/acetic acid (90 + 5 + 5). The recovery of xanthomegnin added to corn samples at levels of 0.75-9.6 mg/kg averaged 41% with a coeff. of variation of 25%. AS

115

Determination of zearalenone in cornflakes and other corn-based foods by thin layer chromatography, high pressure liquid chromatography, and gas-liquid chromatography/high resolution mass spectrometry. Scott, P. M.; Panalaks, T.; Kanhere, S.; Miles, W. F.

Journal of the Association of Official Analytical Chemists 61 (3) 593-600 (1978) [16 ref. En] [Health & Welfare Canada, Health Protection Branch, Food Res. Div., Ottawa, Ontario K1A 0L2, Canada]

A simple cleanup procedure based on pH adjustments was used to obtain extracts of corn foods. The method gave good recoveries of zearalenone determined by TLC and high pressure liquid chromatography (HPLC). As little as 5 ng zearalenone was detected by TLC, using Fast Violet B Salt as the spray reagent; the lower limit of detection in cornflakes was about 20 $\mu\text{g/kg}$. With HPLC on Spherisorb silica (5 μm) and detection by fluorescence at an excitation max. of 310 nm as little as 5 μg zearalenone/kg cornflakes could be determined. While the TLC method was also applicable to corn chips, cornmeal, popcorn, and frozen corn, an interference was observed in HPLC of the latter 3 products. This interference was separated from zearalenone by adding a 2nd HPLC analytical column (Spherisorb ODS). GLC coupled with MS single ion monitoring at high resolution, although of limited availability, was shown to be the most sensitive and selective method for determining zearalenone in corn foods. The natural occurrence of zearalenone in a sample of cornflakes (13-20 $\mu\text{g/kg}$) was demonstrated by all 3 detection procedures. AS

116

[Field studies of zearalenone formation in maize.]

Zearalenon-Bildung bei Körnermais auf dem Feld. Lengauer, E.; Lew, H.; Wimmer, J.

Getreide, Mehl und Brot 32 (3) 55-58 (1978) [30

ref. De] [Landwirtschaftlich-Chem.

Bundesversuchsanstalt, Wieningerstrasse 8, A-4025 Linz, Austria]

The frequency of Fusarium contamination and zearalenone formation in field-grown maize was studied, as was the effect of various cultivation conditions on contamination. 23 var. were grown at 4 locations in Upper Austria (16-19 var./location), with 100-300 kg N/ha, with different plant spacing (70 000-90 000 plants/ha), in monoculture or after wheat, barley, sugar beet or oats with or without ploughing in straw from previous crop. Results show that zearalenone was formed on maize grain in the field, rather than in storage, and to such an extent as to be an agricultural problem. Fusarium and zearalenone contaminations of grains were not highly correlated. All variables examined had some effect on Fusarium and zearalenone contamination; some effects were var. specific, but in general more zearalenone was found in grains at higher N rates, and burning on the field of straw from a previous crop seemed to encourage zearalenone formation. DIH

117

Natural occurrence of ochratoxin A, a kidney-toxic mold metabolite in Scandinavian cereals. [Lecture] Krogh, P.

Zeszyty Problemowe Postepow Nauk Rolniczych No. 189, 21-24 (1977) [14 ref. En, pl. ru] [Royal Vet. & Agric. Univ., Copenhagen, Denmark]

Random samples of (i) brewing quality Danish barley, (ii) fodder barley and oats from Sweden and (iii) feed barley and oats associated with nephropathy cases were analysed for ochratoxin A content by TLC. % samples contaminated in (i)-(iii) resp. were 6, 8 and 58. All the (i) samples contaminated contained < 200 µg ochratoxin A/kg and were judged to be safe for brewing. Use of fodder containing disease-producing levels of toxin endangers human food. [See FSTA (1978) 10 12C454.] DIH

118

Recent studies on Fusarium toxins. [Lecture] Nummi, M.

Zeszyty Problemowe Postepow Nauk Rolniczych No. 189, 189-192 (1977) [En, pl. ru] [Valtion Teknillinen Tutkimuslaitos, Helsinki, Finland]

Abnormally high contamination of Finnish cereal crops with *Fusarium* spp. in 1972 led to the development of methods for screening of cereals for toxic compounds. Bioassays used include mice feeding experiments, epithelial U-cells, and especially observations of inhibition of growth of cultures of *Bacillus subtilis* and *Chlorella vulgaris*. Using these microbiological bioassays, *F. tricinctum* was selected for high toxic activity, and purification of toxins was attempted. Toxins were fractionated by silica gel column chromatography, and fractions obtained were trimethylsilylated and examined by GLC-MS. 4-10 toxins were detected, but were not completely characterized. Further calibration of the GLC method will make it suitable for routine screening of grain. [See FSTA (1978) 10 12C454.] DIH

119

Detection of ochratoxin A in barley using minicolumns of silicagel. [Lecture]

Hald, B.; Krogh, P.

Zeszyty Problemowe Postepow Nauk Rolniczych No. 189, 243-246 (1977) [12 ref. En, pl. ru] [Inst. of Hygiene & Microbiol., Royal Vet. & Agric. Univ., DK-1870 Copenhagen V, Denmark]

A simplified screening method for ochratoxin A content of cereals is described. 50 g finely ground sample are shaken with chloroform/0.1N H₃PO₄ (10:1 v/v) and filtered. The extract is shaken with 0.1N NaHCO₃, the aqueous layer is separated and the pH is adjusted to 2-3 with formic acid. The acidified aqueous solution is then re-extracted with chloroform, and the chloroform layer is evaporated to dryness. The residue is redissolved in 200 µl chloroform, and 100 µl aliquots are applied to silica gel minicolumns (7 cm × 4 mm internal diam.); the sample is washed into the column with

0.6 ml toluene/ethyl acetate/formic acid (5:4:1). Under UV illumination ochratoxin A is a blue-green band approx. 2 cm from the bottom plug. Level of detection is approx. 12 parts/billion, and positive samples may be quantitated by TLC methods. [See FSTA (1978) 10 12C454.] DIH

120

Two new trichothecenes produced by *Fusarium roseum*.

Ishii, K.; Pathre, S. V.; Mirocha, C. J.

Journal of Agricultural and Food Chemistry 26 (3) 649-653 (1978) [15 ref. En] [Dep. of Plant Path., Univ. of Minnesota, St Paul, Minnesota 55108, USA]

Fusarium roseum 'Gibbosum' (3-8-66 No. 10) and *F. roseum* V-18 were isolated from corn harvested in Minnesota, and grown on Czapek medium. Each produced 4 toxic trichothecenes, 3 known compounds (a total of 5 different compounds from the 2 strains) and an uncharacterized trichothecene. The 2 new compounds were characterized by chemical analytical techniques coupled with MS and NMR spectroscopy as 4-acetoxyscirpentiol and 8-acetylnesolaniol, from the 'Gibbosum' and V-18 isolates, resp. DIH

121

Occurrence of T-2 toxin in *Fusarium*-infested sorghum from India.

Rukmini, C.; Bhat, R. V.

Journal of Agricultural and Food Chemistry 26 (3) 647-649 (1978) [15 ref. En] [Nat. Inst. of Nutr., Indian Council of Med. Res., Jamai-Osmania, Hyderabad-500007 AP, India]

Fusarium incarnatum was isolated from naturally infected mouldy sorghum. A toxic metabolite was isolated from this mouldy sorghum as well as from rice artificially inoculated with *F. incarnatum*. This metabolite was demonstrated to be toxic biologically by intraperitoneal injections to rats, skin irritant test in guinea pigs, and rabbit reticulocyte bioassay. Chemical and spectroscopic analysis of the toxic metabolite established its identity as T-2 toxin (3α-hydroxy-4β,15-diacetoxy-8α-(3-methylbutyryloxy)-12,13-epoxy-Δ²-trichothecene). By a combination of biological and chemical tests, T-2 contamination in naturally infected food grains can be detected. AS

122

Production of cyclochlorotine and a new metabolite, simatoxin, by *Penicillium islandicum* Sopp.

Ghosh, A. C.; Manmade, A.; Townsend, J. M.;

Bousquet, A.; Howes, J. F.; Demain, A. L.

Applied and Environmental Microbiology 35 (6) 1074-1078 (1978) [21 ref. En] [SISA Inc., Cambridge, Massachusetts 02138, USA]

In view of the need to establish a practical method for the detection of cyclochlorotine in

natural foods, a study on the microbial production of this toxin was undertaken. Production of the hepatotoxin cyclochlorotine by *Penicillium islandicum* was studied under various fermentation conditions; the best grain system for production was agitated red wheat. A TLC method was developed for detection of cyclochlorotine. The experiments resulted in the isolation of a new toxic metabolite, simatoxin. AL

123

[Formation of cyclopiazonic acid by *Penicillium camemberti* isolates from cheese.] Bildung von Cyclopiazonsäure durch *Penicillium camemberti*-Isolate von Käse.

Still, P.; Eckardt, C.; Leistner, L.

Fleischwirtschaft 58 (5) 876-877 (1978) [13 ref. De, en] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

Following the detection of cyclopiazonic acid (CA) production by isolates of *Penicillium camemberti* from meat products on malt agar (MA), the conditions favouring CA production on MA and in cheese were studied. 43 isolates of *P. camemberti*, from culture collections (24), Camembert cheeses (10) or starter cultures (9) all produced CA when grown at 25°C on MA for 14 days; a max. concn. of 1500 µg/20 ml MA plate was produced after 21-28 days. At 10°C no CA was detected after 14 days, but after 28 days plates contained 125 µg CA. No CA was detected in 12 brands of *P. camemberti*-ripened low-fat lactic cheese, and Camembert and Brie cheeses containing 0.5, 35, 45 and > 50% fat in DM, and none was detected during 9 days' ripening at 14-18°C and 12 days' storage at 8°C. However, cheese stored 5 days at 25°C after normal ripening contained 4 p.p.m. CA. Temp. and time seem to be the critical factors limiting the production of CA in cheese ripened with *P. camemberti*. RM

124

Mycotoxins in animal feedstuffs: animal disease and public health considerations. [Lecture]

Patterson, D. S. P.; Roberts, B. A.

Zeszyty Problemowe Postepow Nauk Rolniczych No. 189, 99-104 (1977) [16 ref. En, pl, ru] [Cent. Vet. Lab., Weybridge, Surrey KT15 3NB, UK]

Details are given of a multi-mycotoxin screening method (for 4 aflatoxins and 8 other mycotoxins) which employs acetonitrile and chloroform as extracting agents and includes a clean-up step involving dialysis against 30% aqueous acetone to eliminate unwanted lipids and plant pigments; TLC is then carried out. Detection limits range from 0.001 (aflatoxin B₁) to 10 p.p.m. (penitrem A). Since 1971 when use of the screening method at Weybridge was begun, only 5 of 203 samples of feedstuffs have been shown to contain identifiable toxins other than aflatoxin; sterigmatocystin, ochratoxin A and zearalenone have been identified in mouldy barley. The danger of transfer of toxins from animal products to man is discussed. [See *FSTA* (1978) 10 12C454.] DMK

125

[Simultaneous determination of the anabolic agent zeranol and its metabolite zearalenone in the p.p.m. range in meat by high-performance liquid chromatography.] Der simultane p.p.m.-Nachweis des anabol wirkenden Zeranols und seines Metaboliten Zearalenon in Fleisch mittels hochauflösender Flüssigkeitschromatographie (HPLC).

Frischkorn, C. G. B.; Frischkorn, H. E.; Ohst, I. M. *Zeitschrift für Lebensmittel-Untersuchung und -Forschung* 167 (1) 7-10 (1978) [8 ref. De, en] [Inst. für Chem., Inst. 4, Angewandte Physikalische Chem., Kernforschungsanlage Jülich GmbH, Postfach 1913, D-5170 Jülich, Federal Republic of Germany]

2 methods for extraction of zeranol or its metabolite zearalenone from meat or liver were compared: (i) comminution, homogenization with sand + anhydrous Na₂SO₄, extraction twice with methanol, separation of the combined extract by centrifugation, evaporation of the methanolic extract to dryness, and re-dissolving of the residue in methanol; and (ii) comminution of the sample, extraction 3 times with chloroform, combination and centrifugation of the extracts, re-extraction of the supernatant with 0.05N NaOH, washing the extract with chloroform, acidification to pH 4 with HCl, re-extraction with chloroform, evaporation of the extract to dryness, and re-dissolving the residue in methanol. Extracts prepared by either (i) or (ii) are then separated by high-performance liquid chromatography on a Dupont ODS-Zorbax column, using a methanol/water (4:6)-methanol/water (9:1) gradient, at 1800 lb/in². Tables of results of analyses on spiked samples are given; although method (ii) gives a lower recovery than method (i), it gives better separation of interfering impurities, and is therefore preferred. Detection limit is 1.5 µg/kg meat. AJDW

126

Mycotoxin production in fermented sausages. [Lecture]

Leistner, L.; Mintzlaff, H. J.; Maing, I. Y.

Zeszyty Problemowe Postepow Nauk Rolniczych No. 189, 69-73 (1977) [24 ref. En, pl, ru] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

Mycotoxin production by *Penicillium* spp. isolated from mould-ripened sausages was investigated, and mycotoxin production in fermented sausages by aspergilli is reviewed. 422 *Penicillium* isolates were screened for production of 9 mycotoxins. 8 isolates, representing 13 identified spp., were toxigenic; the most frequently so identified were *P. viridicatum* (26 strains) and *P. expansum* (14 strains). Mycotoxins produced, in order of frequency, were penicillic acid, ochratoxin A, tremortin A, citrinin and patulin. The spp. associated with each toxin are listed. Fermented sausages ripened with toxin-producing strains did not contain toxin in < 70 days of ripening, and penicillic acid added to raw sausage disappeared during ripening. The 334 strains not found to produce any of the 9 examined toxins were further

studied, using medium extracts in the chick embryo toxicity test. Using olive oil as solvent for the conc. extracts, 128 strains were strongly toxic, compared with 66 strongly toxic strains found using propylene glycol as solvent. Because of production of these unknown mycotoxins it is recommended that only well-characterized non-toxicogenic strains be used for production of fermented sausages; a particular strain of *Penicillium nalgiovensis*, commercially available as 'Edelschimmel Kulmbach', was developed in the authors' laboratory. [See FSTA (1978) 12C454.] DIH

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MYCOTOXINS IN FOODS (EXCLUDING AFLATOXINS & MICROBIAL TOXINS)

SELECTED FROM VOLUME 9

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of

Commonwealth Agricultural Bureaux, Farnham Royal, Bucks; Gesellschaft für Information und Dokumentation, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen.

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H. BROOKES

ASSISTANT EDITOR

MYCOTOXINS

1

Mycotoxins and the other fungal related food problems.
[Conference proceedings]

Rodricks, J. V. (United States of America, American Chemical Society, Division of Agricultural & Food Chemistry) (Editor)
Advances in Chemistry Series 149, xi + 409pp.
ISBN 0-8412-0222-2 (1976) [many ref. En]
Washington, DC, USA

Full version are given of the 18 papers presented at this symposium, sponsored by the Division of Agricultural and Food Chemistry at the 168th Meeting of the American Chemical Society in Atlanta City, New Jersey on 11-13 Sept. 1974. Abstracts of 8 papers have already been covered by FSTA: Conditions leading to mycotoxin contamination of foods and feeds, by C. W. Hesseltine (pp. 1-22, 33 ref.; FSTA (1975) 7 1C16); Occurrence of mycotoxins in foods and feeds, by L. Stoloff (pp. 23-50, 152 ref.; FSTA (1975) 7 1C17); The role of aflatoxin in human disease, by R. C. Shank (pp. 51-57, 22 ref.; FSTA (1975) 7 1C18); Chemical methods investigated for detoxifying aflatoxins in foods and feeds, by A. C. Beckwith, R. F. Vesonder & A. Ciegler (pp. 58-67, 37 ref.; FSTA (1975) 7 1C19); Aspergillus toxins other than aflatoxins, by R. J. Cole (pp. 68-89, 96 ref.; FSTA (1975) 7 1C22); Patulin and penicillic acid, by D. M. Wilson (pp. 90-109, 163 ref.; FSTA (1975) 7 1C23); Stress metabolites of white potatoes, by G. E. Wood (pp. 369-386, 87 ref.; FSTA (1975) 7 1J47); and Toxic furanosesquiterpenoids from mold-damaged sweet potatoes (*Ipomoea batatas*), by L. T. Burka & B. J. Wilson (pp. 387-399, 48 ref.; FSTA (1975) 7 1J49). Other papers presented included: Chemical and biochemical studies of the trichothecene mycotoxins, by R. J. Bamburg (pp. 144-162, 66 ref.); [continued in following abstr.].
AL

2

Mycotoxins and other fungal related food problems.
[Conference proceedings]

Rodricks, J. V. (United States of America, American Chemical Society, Division of Agricultural & Food Chemistry) (Editor)
Advances in Chemistry Series 149, xi + 409pp.
ISBN 0-8412-0222-2 (1976) [many ref. En]
Washington, DC, USA

[Continued from preceding abstr.] Zearalenone and related compounds, by S. V. Pathre & C. J. Mirocha (pp. 178-227, 85 ref.); The chemistry of the epipolythiopiperazine-3,6-diones, by C. Leigh & A. Taylor (pp. 228-285, 139 ref.); Phytopathogenic toxins from fungi: an overview, by H. H. Luke & R. H. Biggs (pp. 296-317, 99 ref.); Helminthosporium, Drechslera, and Bipolaris toxins, by O. L. Shotwell & J. J. Ellis (pp. 318-343, 86 ref.); and The structure and toxicity of the Alternaria metabolites, by D. J. Harvan & R. W. Pero (pp. 344-355, 74 ref.). A further 4 papers are abstracted separately and can be found via the author index under **United States of America**, American Chemical Society, Division of Agricultural & Food Chemistry [Mycotoxins Symposium].
AL

1

3

Tremorgenic mycotoxins. [Lecture]

Ciegler, A.; Vesonder, R. F.; Cole, R. J.
Advances in Chemistry Series 149, 163-177
(1976) [27 ref. En] [N. Regional Res. Lab., USDA, Peoria, Illinois 61604, USA]

The 10 tremorgenic mycotoxins reported in the literature, the structures determined for 5 of them, and investigations into the structure of penitrem A (PA), one of the major unidentified tremorgens, are discussed. Some of the fungal spp. which produce tremorgenic mycotoxins are common contaminants of grains or specific foodstuffs, e.g. *Penicillium crustosum* is a contaminant of various refrigerated foods, grains and cereal products and causes a soft brown rot in apples. [See FSTA (1977) 9 1C16.]
AL

4

Metabolites of various *Penicillium* species encountered on foods. [Lecture]

Pohland, A. E.; Mislivec, P.
Advances in Chemistry Series 149, 110-143
(1976) [146 ref. En] [Bureau of Foods, FDA, Washington, DC 20204, USA]

A survey of the literature concerning the frequency of occurrence of *Penicillium* spp. on foods and feeds shows 13 spp. to be common contaminants. The chemistry and toxicological properties of the metabolites produced by these 13 spp. (*Penicillium cyclopium*, *P. viridicatum*, *P. oxalicum*, *P. expansum*, *P. chrysogenum*, *P. brevicompactum*, *P. funiculosum*, *P. urticae*, *P. islandicum*, *P. cutrinum*, *P. variable*, *P. frequentans*, and *P. purpurogenum*) are discussed. [See FSTA (1977) 9 1C16.]
AL

5

[The significance of byssochlamic acid in fruit juice mould.] Zur Bedeutung der Byssochlaminsäure im Fruchtsaftschimmel.

Fritz, W.; Engst, R.; Donath, R.
Nahrung 20 (5) 539-542 (1976) [15 ref. De, en, ru] [Zentralinst. für Ernährung, Potsdam-Rehbrücke, German Democratic Republic]

A method for detn. of the mycotoxin byssochlamic acid (formed by the mould *Byssochlamys fulva*) in fruit juices is described. The sample is adjusted to pH 11 with NaOH; interfering organic substances are then extracted with chloroform. The aqueous phase is then adjusted to pH 1.0 with conc. HCl, and byssochlamic acid is extracted with chloroform. The extract is then evaporated to dryness, and re-dissolved in chloroform; after clean-up by TLC and column chromatography, the byssochlamic acid is separated by TLC on Kieselgel HF₂₅₄, using acetonitrile/water (45/5) for development. Byssochlamic acid is determined by fluorescence spectrophotometry. Recovery is 80%; detection limit is 0.5 ppm. No byssochlamic acid could be detected in commercial fruit juice samples, or in juices prepared from mouldy fruit.
IN

6

[Gas liquid chromatographic assay of zearalenone in grain.]

Sugimoto, T.; Minamizawa, M.; Takano, K.; Furukawa, Y.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 17 (1) 12-18 (1976) [14 ref. Ja, en] [Central Res. Lab. of Japan Grain Inspection Ass., 8-13, Saga 1-chome, Koto-ku, Tokyo, Japan]

For extraction of zearalenone, the grain sample was treated with NaCl, methanol, chloroform and n-hexane. The solution was chromatographed on a silica gel column, and then GLC was performed, using a flame ionization detector and a column of 1% silicone. The limit of detection of zearalenone was 0.05 ppm. TM

7

Mycotoxins in South African cheeses.

Lück, H.; Wehner, F. C.; Plomp, A.; Steyn, M. *South African Journal of Dairy Technology* 8 (2) 107-110 (1976) [15 ref. En, af] [Anim. & Dairy Sci. Res. Inst., Irene, Transvaal, South Africa]

42 samples of normal cheese, mouldy cheese and mould-ripened cheese (Gouda, Cheddar, Blue-veined and Camembert), manufactured in different parts of the country, were analysed for mycotoxins by standard TLC techniques. No indications were found that the cheeses contained aflatoxins, ochratoxins, sterigmatocystin, patulin or cyclopiazonic acid. *Penicillium* spp. were isolated from 33 of the samples. 46 of these isolates were tested for toxicity to ducklings. Of these 9 were highly toxic and 15 moderately toxic. The only other fungus isolated was *Aspergillus ustus*, which was found on 7 of the samples. All the isolates of *A. ustus* were highly toxic to ducklings. AS

8

[Is there a danger of mycotoxins in Hungarian salami? II. The importance of the casing and of smoke treatment.] Besteht eine Mykotoxingefahr bei der ungarischen Salami? II. Die Bedeutung der Hülle und der Räucherung.

Incze, K.; Frank, H. K.

Fleischwirtschaft 56 (6) 866-868 (1976) [4 ref. De, en, fr] [Ungarisches Forschungsinst. für Fleischwirtschaft, Gubacsi ut. 6/b, H-1097 Budapest, Hungary]

The effects of temp., water activity (a_w), mixed flora and the medium on mycotoxin production, and of smoking on mould growth were studied, as well as penetration of synthetic casings and packaging materials by fungal hyphae, and diffusion of toxins. Nalo, Naturin, Hukki, cellophane and parchment casings allowed variable amounts of penetration by *Aspergillus flavus*, strain 373, *A. parasiticus* 403 and *A. versicolor* 519, 552 and H_{22} during 25 days at 30°C. Hukki and parchment were penetrated in every case, the others only in place with an air space between the substrate and covering material (i.e. imperfect adhesion). None of

the materials prevented diffusion of toxins. Given good adhesion, the Nalo and Naturin casings reduced the growth of the fungi. No toxin was formed when toxigenic strains were grown for 30 days in combination with the mixed salami culture at 13°C. Smoke treatment of the casings (soaking in a solution of smoke components) reduced the growth of toxigenic fungi without affecting the normal ripening flora. [See FSTA (1976) 8 9S1453 for part I.] RM

9

Carcinogenic natural products.

Weisburger, E. K.

Abstracts of Papers, American Chemical Society 172, AGFD 17 (1976) [En] [Carcinogen Metabolism & Toxicology Branch, Nat. Cancer Inst., Bethesda, Maryland 20014, USA]

Exposure to U and associated elements constitutes a cancer risk. Ingestion of high levels of As in drinking water leads to specific types of cancer. Plant products carcinogenic in animals include safrole, cycasin, β -asarone and alkaloids. Tannins have also been implicated as carcinogens. Of utmost importance are the toxic and carcinogenic principles formed by spoilage fungi associated with grain or oilseed crops. These include aflatoxins, sterigmatocystin, and other mycotoxins. In certain areas the high liver cancer incidence of the population is roughly correlated with the degree of aflatoxin contamination of foodstuffs. Chemical methods are available to deactivate aflatoxin, thus making possible the partial salvage of some contaminated crops. AS

10

[Toxic fungi in foods.] Moisissures toxiques dans l'alimentation. [Book]

Moreau, C.

Ed. 2, xi + 471pp. ISBN 2-225-38962-4 (1974) [2938 ref. Fr] Paris, France; Masson & Cie

This revised and enlarged 2nd edition of the book first published in 1968 contains the following chapters: Fungi in foods (pp. 3-30); Mycotoxicoses and mycotoxins (pp. 31-70); Aflatoxicosis (pp. 71-163); Clavacitoxicosis (pp. 165-179); Aspergillotoxicoses (pp. 181-216); Islanditoxicosis (pp. 217-225), caused by *Penicillium islandicum*; Penicilliotoxicoses (pp. 227-248); Fusariotoxicoses (pp. 249-270); Sporidesmiotoxicoses (pp. 271-278), caused by *Pithomyces chartarum*; Stachybotryotoxicosis (pp. 279-286); Various other mycotoxicoses (pp. 287-308); and Future perspectives (pp. 309-322). The book concludes with a bibliography (pp. 323-452) and a subject index (pp. 453-471). JA

11

Fluorescence behavior of sterigmatocystin.

Maness, D. D.; Schneider, W.; Sullivan, G.; Yakatan, G. J.; Scholler, J.

Journal of Agricultural and Food Chemistry 24 (5) 961-963 (1976) [15 ref. En] [Coll. of Pharmacy, Univ. of Texas, Austin, Texas 78712, USA]

12

Fluorodensitometric assay of patulin in apple products.

Salem, T. F.; Swanson, B. G.

Journal of Food Science 41 (5) 1237-1238 (1976)

[12 ref. En] [Dep. of Food Sci. & Tech., Washington State Univ., Pullman, Washington 99163, USA]

A fluorodensitometric assay was developed for quantitative analysis of patulin in apple products. The procedure involves extraction of patulin from apple products with ethyl acetate, cleanup with silica gel column chromatography and preparative TLC. A fluorescent derivative, obtained by exposure of patulin on TLC plates to conc. ammonia fumes, permits convenient quantitative fluorodensitometric assay of patulin. The detection limits were 0.1 µg of pure patulin and 1.0 mg of patulin/l. of apple juice. The mean fluorodensitometric recovery of patulin from apple juice was 97.5%. IFT

13

[Studies on mycotoxins in foods. VI. Detection of aflatoxins in peanuts and peanut products.]

Naai, Y.; Ogawa, H.; Kazama, E.; Saito, K.; Kan, K.; Ibe, A.; Kimura, Y.

Annual Report of Tokyo Metropolitan Research Laboratory of Public Health 26 (1) 179-182

(1975) [2 ref. Ja] [Tokyo Metropolitan Res. Lab. of Public Health, 24-1, Hyakunincho 3 chome, Shinjuku-ku, Tokyo 160, Japan]

See FSTA (1976) 8 9C444 for part V.

14

Aflatoxin and sterigmatocystin contamination of pistachio nuts in orchards.

Sommer, N. F.; Buchanan, J. R.; Fortlage, R. J.

Applied and Environmental Microbiology 32 (1)

64-67 (1976) [13 ref. En] [Dep. of Pomology, Univ. of California, Davis, California 95616, USA]

Aspergillus flavus and *Asp. versicolor* were both shown to be weak pathogens of developing pistachio fruits, producing aflatoxin and sterigmatocystin, respectively. Aflatoxin concn. approached those reported in cereal and legume seeds. Fungus lesions on the fruit hulls were followed by invasion of seeds despite the sclerified shell. Infections and mycotoxins present before harvest would presumably lead to further build-up after harvest if drying was slow or storage was under high humidity. AS

15

Use of the insecticide naled to control zearalenone production.

Berisford, Y. C.; Ayres, J. C.

Journal of Agricultural and Food Chemistry 24 (5) 973-975 (1976) [13 ref. En] [Dep. of Food Sci., Univ. of Georgia, Athens, Georgia 30602, USA]

Naled, applied as a fumigant or in a liquid preparation at levels of 30 and 100 µl/l., completely inhibited zearalenone (F-2) production by *Fusarium graminearum* in liquid media and on

corn. When applied prior to inoculation, naled at 100 µl/l. effectively inhibited F-2 production in liquid media for 15 days, and for 6 and 3 days at concn. of 30 and 10 µl/l., respectively. Although naled did not significantly reduce F-2 production when applied to 12-day or older cultures, it did inhibit F-2 production by 45-92% when applied at concn. of 10-100 µl/l. to 3-9-day old cultures. F-2 production was completely inhibited only when naled was applied prior to inoculation of the culture media. Although naled does partially inhibit additional fungal growth and F-2 production by actively growing cultures, it is a potential protectant only when applied prior to initial growth of the fungus. AS

16

Toxin production by 50 strains of *Penicillium* used in the cheese industry.

Lafont, P.; Lafont, J.; Payen, J.; Chany, E.; Bertin, G.; Frayssinet, C.

Food and Cosmetics Toxicology 14 (2) 137-139

(1976) [9 ref. En] [Unite de Toxicologie

Alimentaire de l'INSERM, 44 Rue du Chemin de Ronde, Le Vesinet, 78110, France]

The possible detection of toxin production by strains of *Penicillium* used in the maturation of blue-moulded or soft-centred cheeses was investigated. The 50 strains of *Penicillium* studied (including 29 of *P. roqueforti* and 2 of *P. camemberti*) were isolated from a variety of French, German, Italian and British fermented cheeses. The strains were isolated on malt-extract agar plates and were grouped, according to series, *P. roqueforti*, *P. camemberti* and others. They were screened using 3 different biological systems, involving the detn. of acute toxicity in the ip-treated mouse and in the chick embryo, and inhibition of the growth of rat-hepatoma cells in vitro. About 1/3 the extracts showed no toxicity, but extracts of 2 strains caused the rapid death of infected mice, 9 gave a clear-cut positive response in 2 tests and 6 gave a strongly positive response in only 1 of the 3 tests. The varied results indicate that the toxic effects produced are not due to a single toxin. A continuation of the work is necessary to determine whether the strains of *Penicillium* that produced toxins in synthetic media may also synthesize toxins under the manufacturing conditions used in cheese production. VJG

17

[Mycotoxin formation in meat products.]

Mykotoxin-Bildung in Fleischwaren. (In

'Rückstände in Fleisch und Fleischerzeugnissen'

[see FSTA (1977) 9 2S164].) [Lecture]

Leistner, L.; Mintzlaff, H.-J.; Maing, I.-Y.

pp. 141-148 (1975) [27 ref. De, en] [Inst. für Bakteriologie & Histologie, Bundesanstalt für Fleischforschung, 865 Kulmbach-Blaich, Federal Republic of Germany]

Potential problems of mycotoxin formation by moulds growing on meat and meat products are discussed, on the basis of literature data. Aspects considered include: desirable and undesirable

Penicillium spp. on meat products (with special reference to mould-ripened products); the formation of hitherto unidentified toxins by Penicillium spp.; the importance of use of non-toxicogenic starters for mould-ripened products; toxin formation by Aspergillus spp. in meat products; and use of potassium sorbate for control of mould growth on sausages, etc. AJDW

18

Mould contamination of meat products.

Hadlok, R.; Samson, R. A.; Stolk, A. C.; Schipper, M. A. A.

Fleischwirtschaft 56 (3) 372-376 (1976) [many ref. En, De, fr] [92 Frankfurter Strasse, 6300 Giessen, Federal Republic of Germany]

425 strains of mould isolated during 10 yr investigations from 207 mould-contaminated meat products (mostly raw cured, from 153 manufacturers) were identified and the results are shown in tables. 239 strains (56.2%) belonged to the genus Penicillium, mainly *P. cyclopium*, *viridicatum*, *chrysogenum* and *frequentans*; 144 strains (33.9%) to the genus Aspergillus, mainly *A. glaucus*, *versicolor*, *flavus* and *fumigatus*. The remaining 42 strains (9.9%) belonged to the orders Moniliales and Mucorales. The results differed from those reported by other authors, possibly due to the material (mould-ripened dry sausage). The most interesting mycotoxins produced by the mycoflora were aflatoxin sterigmatocystin, penicillic acid, cyclopiasonic acid, ochratoxin and tremortin. They were not attributed to individual strains. RM

19

Applications of mass spectrometry to the analysis of mycotoxins. [Review]

Kingston, D. G. I.

Journal of the Association of Official Analytical Chemists 59 (5) 1016-1022 (1976) [19 ref. En] [Dep. of Chem., Virginia Polytech. Inst. & State Univ., Blacksburg, Virginia 24061, USA]

Methods of identifying mycotoxins by MS are reviewed, with special reference to the value of a complete listing of known fungal metabolites, arranged by mol. wt. Such a list is applied to the identification of various mycotoxins, and MS is applied to the structural elucidation of dimethylnidurufin and ostreogrycin A. AS

20

Thin layer chromatographic determination of sterigmatocystin in cereal grains and soybeans.

Shannon, G. M.; Shotwell, O. L.

Journal of the Association of Official Analytical Chemists 59 (5) 963-965 (1976) [12 ref. En] [N. Regional Res. Lab., USDA, Peoria, Illinois 61604, USA]

A method was developed for determining sterigmatocystin in yellow and white corn, barley, oats, rye, sorghum, brown and wild rice, and soybeans. A partition column packed with activated

magnesium silicate was used for cleanup. Average recoveries were 104% in white corn, 114% in rye, 100% in oats, 134% in brown rice, 96% in barley, 105% in sorghum and wild rice, and 92% in soybeans. The limit of sensitivity is 50 µg/kg for any of these commodities. AS

21

Bis-diazotized benzidine as a spray reagent for detecting zearalenone on thin layer chromatoplates.

Malaiyandi, M.; Barrette, J. P.; Wavrock, P. L. *Journal of the Association of Official Analytical Chemists* 59 (5) 959-962 (1976) [11 ref. En] [Lab. Services Sect., Plant Products Div., Agric. Canada, Ottawa, Ontario K1A 0C5, Canada]

Bis-diazotized benzidine is a highly sensitive spray reagent for detecting zearalenone (F-2) in corn samples. As little as 2.0 ng of this Fusarium toxin could be visualized on a thin layer plate after development. In addition, this spray reagent is more specific than the spray reagents currently used for zearalenone. AS

22

[Moulds and mycotoxins in foods.]

Josefsson, E.; Nilsson, G.

Var Foeda 28 (8) 183-188 (1976) [Sv] [Statens Livsmedelsverk, 751 26 Uppsala, Sweden]

23

Investigation of analytical methods for scirpene toxins in food and feed.

Stahr, H. M.

Dissertation Abstracts International, B 37 (2) 681-682: Order No. 76-18291 (1976) [En] [Iowa State Univ., Ames, Iowa, USA]

A method developed for determining T-2 toxin (and other scirpene toxins) in foods and feeds involves extraction of the sample, defatting, decolorization with ferric gel, and partitioning into chloroform for concn. of the extract. TLC and GLC are used to analyse extracts for T-2 toxin; confirmation of the toxin is by MS. IR and NMR spectroscopy are recommended for complete confirmation. Skin-painting is the most specific biological test for scirpenes but chicken embryo testing is less expensive. JA

24

Use of activated charcoal for the removal of patulin from cider.

Sands, D. C.; McIntyre, J. L.; Walton, G. S.

Applied and Environmental Microbiology 32 (3) 388-391 (1976) [14 ref. En] [Dep. of Plant Path. & Bot., Connecticut Agric. Exp. Sta., New Haven, Connecticut 06504, USA]

Penicillium urticae (NRRL 2159A) was grown in culture broth containing 1 µCi of [1-¹⁴C]acetate to produce [¹⁴C]patulin. [¹⁴C]patulin was purified from the broth and added to apple cider. After the patulin concn. of the cider was adjusted to 30

µg/ml with unlabelled patulin, the cider was subjected to various charcoal treatments. [¹⁴C]patulin was completely removed by shaking the cider with 20 mg of activated charcoal/ml and by eluting the cider through a 40- to 60-mesh charcoal column. Activated charcoal at 5 mg/ml reduced patulin in naturally contaminated cider to non-detectable levels. AS

25

[Patulin in apple drinks.]

Josefsson, E.; Andersson, A.

Var Foeda 28 (8) 189-196 (1976) [16 ref. Sv, en] [Statens Livsmedelsverk, 751 26 Uppsala, Sweden]

66 samples of commercial apple juice were analysed for the mycotoxin patulin by GLC; presence of patulin was confirmed by MS or TLC. 29 samples contained >2.5 µg patulin/l. (8 containing 2.5-5.0 µg/l., 9 containing 5-10 µg/l., 9 containing 10-15 µg/l., 2 containing 15-20 µg/l., and 1 containing 27 µg/l.). No patulin was detected in 5 non-mouldy apples; patulin was present in 5 of 8 mouldy apples, the highest patulin concn. found being 165 mg/kg. Studies on the stability of patulin in cold-stored apple juice are briefly described. AJDW

26

Separation, identification, and quantitative determination of patulin in apple products.

Stinson, E. E.; Huhtanen, C. N.; Zell, T. E.; Schwartz, D. P.; Osman, S. F.

Abstracts of Papers, American Chemical Society 172, AGFD 114 (1976) [En] [E. Regional Res. Cent., USDA, 600 East Mermaid Lane, Philadelphia, Pennsylvania 19118, USA]

Preparative TLC employing the 2,4-dinitrophenylhydrazone derivative was used successfully in a simple method for separation, identification, and measurement of patulin in apple products. The concn. of purified phenylhydrazone derivative in the final solution can be evaluated by either visual or spectrophotometric comparison with standard solutions. Decomposition of patulin at key points of the procedure is prevented. This method provides quantitative values for samples containing materials interfering with determination of patulin by other analytical procedures. The method has been developed with emphasis on detection of levels of patulin in the range 50-340 parts/billion. AS

27

[Moulds and patulin in frozen bilberries.]

Akerstrand, K.; Molander, A.; Andersson, A.; Nilsson, A.

Var Foeda 28 (8) 197-200 (1976) [4 ref. Sv, en] [Statens Livsmedelsverk, 751 26 Uppsala, Sweden]

16 samples of frozen bilberries (implicated in an outbreak of food poisoning) were examined for moulds and mycotoxins. A table of results is given

showing mould spp. identified, patulin concn. in the sample, and the patulin-forming capacity of the moulds isolated. 10 of the 16 samples contained *Penicillium expansum*; of these isolates, almost all were capable of forming patulin. 3 samples of the bilberries contained patulin, at concn. of 75, 95 and 190 µg/kg. 6 samples of frozen bilberries from other sources were also tested; none contained *P. expansum* or patulin. AJDW

28

Gas-liquid chromatography and mass spectrometric ion selective detection of sterigmatocystin in grains.

Salhab, A. S.; Russell, G. F.; Coughlin, J. R.; Hsieh, D. P. H.

Journal of the Association of Official Analytical Chemists 59 (5) 1037-1044 (1976) [23 ref. En] [Dep. of Food Sci. & Tech., Univ. of California, Davis, California 95616, USA]

A method was developed for direct GLC-MS analysis of nonderivatized sterigmatocystin in wheat, rice, barley and corn. Sterigmatocystin was extracted from spiked grain samples by 2 methods, both of which yielded high recoveries of ¹⁴C-labelled sterigmatocystin (>90%). Extracts were cleaned up by gel permeation chromatography on polystyrene with tetrahydrofuran as the eluant. Chromatography of ¹⁴C-labelled compound indicated good recoveries (>90%). The GLC-MS system was modified to give an all-glass chromatographic pathway to the ion source. Short glass or quartz columns packed with silicone liquid phase on inert supports gave best results. Trace levels of sterigmatocystin were very labile in all gas chromatographic systems and levels of <5 parts/billion in grains were detected only with great difficulty. The GLC-MS system was utilized in the mass fragmentography mode, with selective ion monitoring of m/e 295, 306 and 324 peaks. These ions were present in trace levels in all control grain samples, indicating minimal interference from other compounds. The limit of accurate detectability (20 ng) on spiked grain samples was lower than previously reported. Lower levels of sterigmatocystin (1 part/billion or 4 ng on column) could be detected in grains by using the mass fragmentography mode, but these levels could not be measured accurately. AS

29

Determination of sterigmatocystin in corn and oats by gel permeation and high-pressure liquid chromatography.

Stack, M. E.; Nesheim, S.; Brown, N. L.; Pohland, A. E.

Journal of the Association of Official Analytical Chemists 59 (5) 966-970 (1976) [10 ref. En] [Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

Corn and oats samples are extracted with acetonitrile-water, followed by partition of the extract against hexane, transfer to chloroform, and elution from a silica gel column. The extract is purified by gel permeation chromatography on an

automatic instrument. Reverse phase high-pressure liquid chromatography, using a 254 nm UV detector and 0.1M KH_2PO_4 -acetonitrile (7 + 5) as the mobile phase, is used for quantitation. The average recovery from samples of corn to which 0, 25, 50 or 100 μg sterigmatocystin/kg had been added was 59%, with a coeff. of variation of 8.4%. The average recovery from oats fortified at the same levels was 74%, with a coeff. of variation of 12%. A confirmation procedure based on hemiacetal derivative formation on a TLC plate is also described. AS

30

[Short-chain fatty acids as preservatives in cereals and cereal products.] [Lecture]

Widhe, T.

SIK Rapport No. 384, 53-60 (1975) [Sv] [AB Juvel, Stockholm, Sweden]

Problems with growth of microorganisms in stored grain, flour and bread are discussed, with special reference to toxigenic moulds. Effects of storage conditions, factory hygiene, etc. on the microbiological quality of cereals and cereal products are considered. The potential for use of short-chain fatty acids and other acids (including acetic, propionic, isobutyric, lactic, sorbic and myristic acids) as preservatives in grain, flour and bakery products is discussed, with reference to effects of these preservatives on the quality of the product. [See also FSTA (1977) 9 3E89.] AJDW

31

Screening of toxic isolates of *Fusarium poae* and *Fusarium sporotrichioides* involved in causing alimentary toxic aleukia.

Yagen, B.; Joffe, A. Z.

Applied and Environmental Microbiology 32 (3) 423-427 (1976) [40 ref. En] [Dep. of Natural Products, School of Pharmacy, Hebrew Univ., Jerusalem, Israel]

A total of 131 isolates of *F. poae* and *F. sporotrichioides* from overwintered cereals [wheat, rye, millet, barley] associated with alimentary toxic aleukia toxicoses in the Soviet Union were tested for their ability to produce T-2 toxin [4 β ,15 diacetoxy-8 α -(3-methylbutyryloxy)-12,13-epoxytrichothec-9-en-3 α -ol]. The Presence of T-2 toxin was determined by TLC, GLC, spectroscopic analyses, and the rabbit skin test. A good correlation was demonstrated between T-2 toxin detection by TLC and inflammatory skin reactions of rabbits. >95% of the isolates produced T-2 toxin in various quantities. AS

32

Radiation sensitivity of some toxigenic molds isolated from deteriorated rice.

Choi, E.-H.; Kim, H.-L.; Lee, S.-R.

Korean Journal of Food Science and Technology 7 (3) 148-153 (1975) [26 ref. En, ko] [Agric. Biochem. Lab., Korea Atomic Energy Res. Inst.,

Seoul, Korea]

7 moulds (4 *Aspergillus* spp., 3 *Penicillium* spp.) isolated from spoiled rice and reported to be capable of producing mycotoxins were examined for their sensitivity to γ -rays from a ^{60}Co source. 2-ml aliquots of suspensions containing 10^7 - 10^8 conidia/ml were irradiated at dose rates of 2.67 or 11.56 krad/min. The irradiated suspensions were diluted, plated, incubated for 3-5 days at 30°C and the colonies counted. Conidia of all spp. showed survival curves of a sigmoidal type. Decimal reduction doses and induction doses were deduced from the survival curves. With a dose rate of 11.56 krad/min, D_{10} values (the radiation dose required to kill 90% of the test organisms) ranged from 14 (*P. citrinum*) to 33 (*Asp. fumigatus*) krad, the induction dose from 12 (*P. implicatum*) to 56 (*Asp. ochraceus*) krad, and the inactivation factor at 200 krad from 4.6 (*Asp. fumigatus*) to 12.8 (*P. citrinum*). D_{10} values were higher at the lower dose rate but the induction dose was the same for both rates. The relevance of these results to the development of food irradiation methods is discussed. JA

33

[Studies on the fungi containing milk and the milking environment. II. Influence of the fungi isolated on the quality of milk and the fungal toxicity bioassay by chick embryo test.]

Nakae, T.; Yoneya, T.

Japanese Journal of Dairy and Food Science [Rakuno Kagaku Shokuhin no Kenkyu] 25 (4) A113-A118 (1976) [17 ref. Ja, en] [Lab. of Anim. Products Tech., Fac. of Agric., Okayama Univ., Okayama, Japan]

Incubation of fungi (isolated from raw milk), in skim-milk at 25°C caused little change in pH or titratable acidity, but proteolysis and lipolysis (in market milk) occurred especially in the case of *Aspergillus flavus* and *Rhizopus* sp. Six of the 39 strains tested showed fungal toxicity to chick embryo in the bioassay i.e. *Aspergillus candidus*, *A. niger*, *A. ochraceus*, *A. terreus*, *Alternaria* sp. and *Mucor* sp. 10 strains of *A. flavus* however, which is known as an aflatoxin producer, were not toxic. [From En summ.] HLR

34

The occurrence and control of mycotoxins and mycotoxicoes.

Rodricks, J. V.

Food and Nutrition 2 (1) 9-14 (1976) [11 ref. En] [Div. of Chem. & Physics, FDA, DC, USA]

Consideration is first given to the use of the terms mycotoxins and mycotoxicoes. 3 categories are defined into which mycotoxins and mycotoxicoes fall: (i) mycotoxicoes which can be attributed to specific mycotoxins or groups of mycotoxins; (ii) mycotoxicoes for which the specific, causative mycotoxin(s) has not been identified; and (iii) mycotoxins which have been identified as natural contaminants of foods or feeds

but for which no specific mycotoxicosis has been identified. Control of mycotoxicoses is discussed, and the current aflatoxin situation is summarized. Tabulated data are presented on: some important mycotoxins (name of mycotoxin and major producing fungus); some important toxicoses of man and animals in which mycotoxins are involved (toxicosis, affected spp., food source, mycotoxin, and category); and some mycotoxins found as food contaminants but for which the human health risk is uncertain or completely unknown (mycotoxin-susceptible foods, and possible human health consequences of long-term ingestion). VJG

35

A consideration of the mycotoxin hypothesis with special reference to the mycoflora of maize, sorghum, wheat and groundnuts. [Review]

Martin, P. M. D.; Gilman, G. A.

Report, Tropical Products Institute G105, vii + 112pp. ISBN 0-85954-054-5 (1976) [35pp. of ref. En] Price £2.00 [Tropical Products Inst., 56/62 Gray's Inn Road, London WC1X 8LU, UK]

This review aims to trace the connection between the mycology of foodstuffs and the onset of disease due to the toxins that various fungi produce within those foodstuffs. The information is arranged under the following headings: The physiology of fungi in relation to harvesting and storage (pp. 4-18); The natural incidence of fungi in foodstuffs (pp. 19-22); The ecology of mycotoxin formation (pp. 23-30); The natural occurrence of mycotoxins (pp. 31-34); The role of fungi in non-invasive pathology (pp. 35-51), including allergic illness and mycotoxicosis; and The association of mycotoxins with malignant disease (pp. 52-62). 9 appendices are included: Mycotoxicosis with multiple aetiology: some of the main syndromes (pp. 66-67); Mycotoxicosis caused by aflatoxin, primarily involving the liver (p. 68); Disease syndromes associated with *Fusarium graminearum* (p. 69); Disease syndromes associated with *Fusarium sporotrichioides* (p. 70); Mycotoxicosis attributable to *Stachybotrys alternans* (p. 70); Mycotoxicosis caused by rusts and smuts (p. 71); Other toxigenic fungi (pp. 72-73); Summary of the chief mycotoxins and their causal agents (pp. 74-75); and Summary of the chief toxigenic fungi whose metabolites have been named and/or chemically determined (pp. 76-77). VJG

36

[The current position in mycotoxin research.] Wo steht die Mykotoxinforschung heute?

Frank, H. K.

Umschau in Wissenschaft und Technik 76 (24) 785 (1976) [2 ref. De] [Bundesforschungsanstalt für Ernährung, Karlsruhe, Federal Republic of Germany]

Recent developments in mycotoxin research are briefly considered, with reference to: toxicity and carcinogenicity; detoxification of contaminated

foods or feeds; analytical methods; possible methods for control of growth and toxin biosynthesis by fungi on foods; and the health hazard from mouldy foods. AJDW

37

An assay of sterigmatocystin and related metabolites of *Aspergillus versicolor* by high speed liquid chromatography.

Ito, K.; Yamane, A.; Hamasaki, T.; Hatsuda, Y. *Agricultural and Biological Chemistry* 40 (10) 2099-2100 (1976) [14 ref. En] [Food Tech. Inst. of Tottori Prefecture, Sakaiminato, Tottori 684, Japan]

38

[Danger to human health of mycotoxins.]

Gefährdung der menschlichen Gesundheit durch Mykotoxine. [Review]

Reiss, J.

Zeitschrift fuer Ernahrungswissenschaft 15 (2) 168-176 (1976) [many ref. De, en] [Mikrobiol. Lab., Grahamhaus Studt KG, Bad Kreuznach, Federal Republic of Germany]

39

Topical bacteriological problems.

Schenkel, J.

CCB Review for Chocolate, Confectionery and Bakery 1 (4) 37-38 (1976) [12 ref. En]

The occurrence of *Salmonella* and moulds in chocolate and the effects of the toxins are described. *Salmonella* can be present on or in certain raw materials used by the chocolate industry, they can survive low roasting temp., can be carried in cocoa dust, and cannot safely be destroyed by conching even at temp. of 72°C. All raw materials suspected of harbouring *Salmonella* should be carefully examined prior to entering the factory, and the importance of hygiene observance by personnel is stressed. Moulds and their toxins (aflatoxins and others) are discussed, together with the difficulty in detecting them in cocoa beans and intermediate cocoa products. AL

40

[Analysis of mycotoxins. V. Systematic analysis of mycotoxins in grains.]

Takeda, Y.; Isohata, E.; Amano, R.; Uchiyama, M.; Naoi, Y.; Nakao, M.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 17 (2) 193-199 (1976) [4 ref. Ja, en] [Nat. Inst. of Hygienic Sci., Kamiyoga 1-chome, Setagaya-ku, Tokyo, Japan]

Systematic analysis for the simultaneous detn. of the fluorescent mycotoxins aflatoxins B₁, B₂, G₁ and G₂, sterigmatocystin, ochratoxin-A and citrinin in grains was studied. The mycotoxins were extracted with H₂SO₄, KCl and acetonitriles,

fractionated by silica gel column chromatography, and determined by TLC. [See FSTA (1975) 7 7M783 for part IV.] . TM

41

[Microbial spoilage of foods.] Mikrobieller Verderb von Lebensmitteln.
Schmidt-Lorenz, W.

Temperatur Technik 14 (4) 95-100 (1976) [De]
[Eidgenössische Tech. Hochschule, Zürich, Switzerland]

After a brief survey of environmental and historical aspects of the nature and occurrence of microorganisms, the microbial contamination of foodstuffs, the conditions under which microorganisms are most likely to be encountered, and the means available for their detection are discussed. Some common causes of food poisoning are discussed, including the slow cooling of large amounts of meat or gravy in catering establishments; the highly toxic nature of mycotoxins produced in stored grains is emphasized. The development of visible or organoleptic signs of spoilage is correlated with the rate of growth of bacteria in certain products, including beef and poultry. BDH

42

Carbon-13 nuclear magnetic resonance assignments in the trichothecene mycotoxins.

Ellison, R. A.; Kotsonis, F. N.

Journal of Organic Chemistry 41 (3) 576-578 (1976) [14 ref. En] [School of Pharmacy, Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

¹³C NMR was used for structure assignments in the trichothecene mycotoxins (sesquiterpenes produced by several genera of fungi and implicated in a number of epidemic diseases resulting from the ingestion of mouldy foods). RM

43

[The problem of mycotoxins in foods.] Das Problem der Mykotoxine in Lebensmitteln.
[Lecture]

Frank, K. H.

Chimia 30 (10) 455-456 (1976) [8 ref. De]
[Bundesforschungsanstalt für Ernährung, Engesserstrasse 20, D-75 Karlsruhe 1, Federal Republic of Germany]

The occurrence, formation and toxicity of mycotoxins in foods are briefly reviewed, with particular reference to aflatoxins, sterigmatocystin and patulin. RM

44

Do mycotoxins present a potential hazard for intermediate moisture foods? (In 'Intermediate moisture foods' [see FSTA (1977) 9 5G328].)

[Lecture]

Jarvis, B.

pp. 239-247 (1976) [31 ref. En] [Leatherhead Food Res. Ass., Randalls Road, Leatherhead, Surrey, UK]

About 200 microfungi are capable of producing mycotoxins (most also able to grow in reduced water activity conditions), although many have not yet been implicated in clinical outbreaks. Factors affecting growth and toxin production by a few mycotoxinogenic fungi are briefly considered, together with the implications for manufactured intermediate moisture foods. AL

45

Proceedings of the 3rd International Biodegradation Symposium. Sessions IV, XIV.
[Conference proceedings]

Sharpley, J. M.; Kaplan, A. M. (Editors)
v + 523-649pp. ISBN 0-85334-706-9 (1976)
[many ref. En] Barking, Essex, UK; Applied Science Publishers Ltd. Price £7.00 [Sharpley Lab. Inc., Fredricksburg, Virginia, USA]

This book contains Session IV (Biodegradation of agricultural products) and Session XIV (Postharvest deterioration and mycotoxins) of the 3rd International Biodegradation Symposium held at the University of Rhode Island (Kingston, USA). Papers presented at Session IV include:

Biodeterioration of sweetwaters in sugar refining, by R. H. Tilbury, C. J. Orbell, J. W. Owen & M. Hutchinson (pp. 533-543, 13 ref.), which reports a microbiological survey of sweetwaters, the aim being to locate those parts in the refining process where microbial growth occurs, to isolate and identify the biodeteriogenic microorganisms, to quantify the losses incurred, and to devise acceptable control measures; Biodegradation of brewer's grains. I, by J. R. Edwards & R. N. Smith (pp. 545-551, 11 ref.), which reports studies of biodegradation by pure cultures of 6 mesophilic and 3 thermophilic fungi; and Biodegradation of brewers' grains. II, by R. N. Smith, D. E. Odell & J. R. Edwards (pp. 553-559, 12 ref.), which reports studies of biodegradation by fungi in dual and tandem cultures. Papers presented at Session XIV were: Chemical control of postharvest diseases [in agricultural products], by J. M. Ogawa, B. T. Manji & A. H. El-Behadli (pp. 561-575, 31 ref.); [continued in following abstr.]. JA

46

Proceedings of the 3rd International Biodegradation Symposium. Sessions IV, XIV.
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[Continued from preceding abstr.] Nonchemical control of postharvest deterioration of fresh produce, by W. L. Smith, Jr. (pp. 577-587, 42 ref.); Nature and importance of mycotoxins in grains, by U. L. Diener, N. D. Davis & G. Morgan-Jones (pp.

589-605, 73 ref.); Mycotoxins other than aflatoxins, by C. W. Hesseltine (pp. 607-623, 68 ref.), e.g. penicillic acid, patulin, sterigmatocystin, *Alternaria* toxins, emetic and rejection factors, zearalenone, ochratoxin, citrinin, T-2 toxin; An evaluation of environmental factors and occurrence of aflatoxin in Virginia shelled peanuts: 1964 to 1968, by C. A. Sledd, T. Eadie, C. E. O'Rear & G. C. Llewellyn (pp. 625-634, 23 ref.); Degradation of barley by *Aspergillus fumigatus* Fres., by P. N. Sellars, C. E. G. McGill & B. Flannigan (pp. 635-643, 15 ref.); and Microbial rot of cocoyam (*Xanthosoma sagittifolium* (L) Schott) in storage in Nigeria, by S. K. Ogundana (pp. 645-649, 11 ref.). A subject index is included. JA

47

[New method for determining patulin in fruit juices and concentrates.] Über eine neue Patulinbestimmung in Fruchtsäften und Konzentraten.

Tanner, H.; Zanier, C.

Schweizerische Zeitschrift fuer Obst- und Weinbau 112 (26) 656-662 (1976) [4 ref. De]

[Eidgenössische Forschungsanstalt, Wädenswil, Switzerland]

Patulin was determined in Swiss apple juices by (i) fluorodensitometry (involving extraction according to Scott & Kennedy [FSTA (1973) 5 11H1816], TLC purification according to Salem & Swanson [FSTA (1977) 9 2H143] and visualization of spots with 3-methyl-2-benzothiazolinone hydrazone hydrochloride [Journal of Chromatography (1973) 86, 190] and (ii) by high-pressure liquid chromatography using isopropyl ether/tetrahydrofuran (95:5) with 0.1% glacial acetic acid as the liquid phase. (i) and (ii) procedures are described in detail. They gave closely agreeing results. Mean frequency distribution values for patulin content of 42 juice samples obtained by the methods were ($\mu\text{g/l.}$): < 5, 23 samples (55%); 5-10, 3 samples (7%); 10-15, 4 samples (9.5%); 15-25, 7 samples (16.5%); 25-50, 5 samples (12%); and > 50, 0 samples. For a total of 47 foreign juices, the distribution was ($\mu\text{g/l.}$): < 20, 14 (30%); 20-50, 16 (34%); and > 50, 17 (36%). The WHO max. tolerance for patulin is 50 $\mu\text{g/kg}$. SKK

48

[Patulin in foods of plant origin. I. Pome fruits and their products.] Patulin in Lebensmitteln pflanzlicher Herkunft. I. Kernobst und daraus hergestellte Produkte.

Frank, H. K.; Orth, R.; Hermann, R.

Zeitschrift fuer Lebensmittel-Untersuchung und -Forschung 162 (2) 149-157 (1976) [30 ref. De, en] [Bundesforschungsanstalt für Ernährung, Engesserstrasse 20, D-7500 Karlsruhe, Federal Republic of Germany]

Conditions affecting the formation of patulin in the flesh of apples and pears during storage and its stability during subsequent cooking were examined in view of its reported toxic effects in laboratory

animals. Patulin was found to occur following mould spoilage (brown rot), but it was confined to the areas of spoiled tissue which are normally removed prior to consumption. The rate of formation was higher at room temp. than during storage in a controlled atm at 1-4°C, corresponding to the rate of development of brown rot. In apples stored at 4°C for 4-5 months and then held at 22°C for 72 h, the patulin content of the rotten portion approached 1 mg/g. The toxin was shown to be heat labile; concn. in deliberately contaminated samples of apple puree were reduced 10× after heating for 10 min in contact with water. BDH

49

[Determination of sterigmatocystin by gas-liquid chromatography with an electron capture detector.] Suzuki, T.; Hoshino, Y.; Kikuchi, Y.; Nose, N.; Watanabe, A.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 17 (3) 253-257

(1976) [13 ref. Ja, en] [Saitama Inst. of Public Health, Kamiookubo-higashi, Urawa-shi, Japan]

Sterigmatocystin is extracted from cereals with a mixture of methanol, NaCl and chloroform. After column chromatography on a combined column of silica gel and Florisil and on Sephadex LH-20 gel, the trimethylsilyl (TMS) derivative is obtained by use of N,O-bis TMS trifluoroacetamide in ethyl acetate. The TMS derivative is determined by electron capture detection GLC on a column (3 mm × 50 cm) of 2% OV-17. The limit of detection is about 10 parts/billion sterigmatocystin. TM

50

Carbon-13 nuclear magnetic resonance studies of fungal metabolites, aflatoxins and sterigmatocystins. Cox, R. H.; Cole, R. J.

Journal of Organic Chemistry 42 (1) 112-114 (1977) [12 ref. En] [Chem. Dep., Univ. of Georgia, Athens, Georgia 30602, USA]

¹³C-NMR has become a valuable tool for identification of carcinogenic fungal metabolites that are widely distributed in human and animal foods. ¹³C NMR spectra are reported for 12 of the fungal metabolites which contain the fused bihydrofuran ring system and are produced by certain strains of *Aspergillus flavus*, *A. parasiticus* and *A. versicolor*. Included are the aflatoxins B₁, B₂, B_{2a}, B₃ (parasiticol), D₁, G₁, gG₂ and gG_{2a}, and sterigmatocystin and its dihydro, o-methyl and o-methyl dihydro derivatives. Chemical shifts have been assigned on the basis of known substituent effects, off-resonance decoupling experiments and comparison among the related compounds. AS

51

[Production of T-2 toxin from stationary culture of *Fusarium solani*.] Herstellung von T-2 Toxin unter Einsatz von *Fusarium solani* in ruhender Kultur. Sato, N.; Amano, R.

Fleischwirtschaft 56 (9) 1354-1355 (1976) [De, en] [Bundesanstalt für Fleischforschung, 8650

Kulmbach, Federal Republic of Germany]

F. solani NHL-F-111 produced 2.5 g of T-2 toxin in 11.2 l. of liquid medium after 7 days' stationary culture at 25°C; 1.54 g of crystalline toxin was recovered by a simple extraction method. AS

52

Naturally occurring toxicants in foods and their significance. [Lecture]

Munro, I. C.

Clinical Toxicology 9 (5) 647-663 (1976) [40 ref.

En] [Health Protection Branch, Ottawa, Ontario, Canada]

Naturally occurring toxins include mycotoxins (e.g. ergot alkaloid and aflatoxins), allergens, chemical factors (e.g. nitrosamines, heavy metals) and plant toxins, such as those responsible for lathyrism. The groups are discussed with reference to current toxicological understanding of their occurrence and effects. JRR

53

[Mycotoxins.] [Conference proceedings]

France, Comité Scientifique 'Contamination des Chaines Biologiques'

Cahiers de Nutrition et de Dietetique 11 (2, supplement) 120pp. (1976) [many ref. Fr]

The following papers were presented at this conference held in Toulouse on 16-19 Sept. 1975: Mycotoxins: current problems, by C. Frayssinet & P. Lafont (pp. 7-8, Fr); Toxic mycoflora, by J. Payen (pp. 11-15, 28 ref., Fr); Vectors of mycotoxins, by C. Labouche (pp. 17-22, 14 ref., Fr); Ecology of toxinogenic moulds, by J. le Bars (pp. 23-29, 31 ref., Fr); Determination of mycotoxins, by M. Jemmali (pp. 31-35, 13 ref., Fr); Human mycotoxicoses, by P. Lafont & J. Lafont (pp. 39-47, 103 ref., Fr); Suitable tests for detecting the carcinogenic potential of mycotoxins, by Y. Moule, E. Chany & A. Sarasin (pp. 49-58, 56 ref., Fr); Mycotoxins and microorganisms, by J. Lafont, S. Renom de la Baume & P. Lafont (pp. 59-69, 126 ref., Fr); Structure, metabolism and toxicity of the aflatoxins: a review, by D. S. P. Patterson (pp. 71-76, 42 ref., En); Fusarium toxins responsible for leucopenic diseases, by C. Frayssinet & P. Lafont (pp. 77-82, 23 ref., Fr); Toxicological and metabolic considerations of ochratoxin A, by P. Galtier (pp. 83-87, 25 ref., Fr); Production and toxicity of patulin, by L. Escoula (pp. 89-93, 25 ref., Fr); Application of bio-autography for detecting patulin, by R. Capitaine (pp. 95-97, 16 ref., Fr); Reduction of aflatoxin levels in peanuts through agricultural techniques, by A. Bockelee-Morvan & P. Gillier (pp. 101-104, Fr); and Development of methods for eliminating aflatoxins from oilseed products, by A. Prevot (pp. 105-116, Fr). JA

54

[Is there a danger of mycotoxins in Hungarian salami? III. Chemical and biological investigations with samples of sliceable salami.] Besteht eine Mykotoxingefahr bei der ungarischen Salami? Incze, K.; Mihalyi, V.

Fleischwirtschaft 56 (11) 1616-1618 (1976) [15 ref. De, en, fr] [Bundesforschungsanstalt für Ernährung, Engesserstrasse 20, 7500 Karlsruhe, Federal Republic of Germany]

The inhibition of mycotoxin formation during ripening of Hungarian salami by mixed salami flora or *Penicillium nalgiovensis* was confirmed under conditions simulating production practice. 4-wk-old salami sausages were surface-inoculated with mixed salami flora or *P. nalgiovensis* and conidial suspensions of toxigenic strains of *Aspergillus parasiticus*, *A. flavus* and *A. versicolor* and allowed to mature for 2 months at 10°-13°C, 80-85% RH. Chemical analysis of 800 samples of sausage skins and contents revealed no aflatoxin, sterigmatocystin, penicillic acid, ochratoxin, patulin or citrinin. Biological tests (chick embryo tests) confirmed the absence of any mycotoxin. [See FSTA (1977) 9 1567 for part II.] RM

55

[Problems with mycotoxins in the meat industry.]

Incze, K.

Husipar 25 (4) 153-158 (1976) [32 ref. Hu, en, de, ru] [Országos Husipari Kutatóintézet, Gubacsi út 6/b, 1097 Budapest, Hungary]

56

[Application of high performance-liquid chromatography to the quantitative analysis of aflatoxins and mycotoxins in press cakes and by-products.] [Lecture]

Blanc, M.; Midler, O.; Karleskind, A.

Oleagineux 31 (11) 495-499 (1976) [3 ref. Fr, en, es] [Lab. Wolff, 198 rue Sigmund Freud, 75019 Paris, France]

High performance liquid chromatography on silica microparticles (5 µm) gives good resolution of aflatoxins in the order B₁-B₂-G₁-G₂. A simple, quick method for aflatoxin detn. in press cakes was developed, using the chloroform extract without prior purification. The method has a sensitivity of 1 ng, with very good repeatability. Analysis of aflatoxins by high performance liquid chromatography with spectrophotometric detn. at 362 nm was more sensitive and accurate than current TLC and fluorescence analysis methods. The method can also be used for detn. of other mycotoxins e.g. ochratoxin, zearalenone, patulin, aflatoxin M (in milk), and sterigmatocystin. AS

57

[Fungal contamination of food.] *Le contaminazioni fungine degli alimenti.* [Book] Cirilli, G.

175pp. (1976) [93 ref. It] Pinerolo, Italy; Chiriotti Editori Price L10 000

This well-illustrated account of fungal contamination of foods contains the following chapters: Basic aspects of mycology and the biology of fungi (pp. 13-38); Culture methods and toxicity tests (pp. 39-53); Mycotoxins (pp. 55-65);

Toxigenic fungi (pp. 67-107); Methods for detection and detn. of mycotoxins (pp. 109-124); Symptoms of mycotoxicoses in animals (pp. 125-140); Fungal contamination of various foods (pp. 141-158); Prevention and control of fungal contamination (pp. 159-166); and Yeasts as a source of protein: *Toprina* (pp. 167-172). AJDW

58

Field desorption mass spectrometry of mycotoxins and mycotoxin mixtures, and its application as a screening technique for foodstuffs.

Sphon, J. A.; Dreifuss, P. A.; Schulten, H.-R. *Journal of the Association of Official Analytical Chemists* 60 (1) 73-82 (1977) [12 ref. En] [Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

The field desorption mass spectra of a variety of mycotoxins were studied. The mycotoxins included the 4 aflatoxins (B_1 , B_2 , G_1 , G_2), rubratoxin B, T-2 toxin, and zearalenone, as well as mixtures of these mycotoxins. The spectra of all the mycotoxins exhibited molecular ions $[M]^+$. Under the conditions employed, only rubratoxin B exhibited major fragmentation. The field desorption technique was applied to the analysis of both spiked and naturally contaminated extracts of foodstuffs [e.g. corn, tomatoes, peanut butter]. The potential of the method as an analytical screening technique for the presence of mycotoxins was evaluated.

AS

59

Methods to purify and determine rubratoxins. Emeh, C. O.; Marth, E. H.

Zeitschrift fuer Lebensmittel-Untersuchung und -Forschung 163 (2) 115-120 (1977) [28 ref. En, de] [Dep. of Food Sci., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

Several extractive and chromatographic procedures for isolating and detecting rubratoxins and, in some instances, for purifying them in amounts sufficient for experimental purposes were evaluated. The studies included consideration of the effects of various solvents on the recovery of rubratoxins A and B from corn, polished rice and soybeans inoculated with 1 ml of a suspension of *Penicillium rubrum* spores (5×10^5 spores) and incubated. Greatest recoveries of rubratoxin A were achieved as follows: 0.95 mg/g from corn by successive extractions with ethyl alcohol (twice), acetone (twice) and ethyl acetate; 0.48 mg/g from

rice by extraction with ethyl acetate (20-80%) in benzene; 0.51 mg/g from soybeans by refluxing with diethyl ether at 45°C for 4 h. Greatest recoveries of rubratoxin B were achieved as follows: 1.89 mg/g from corn and 1.45 mg/g from soybeans by refluxing with diethyl ether at 45°C for 4 h; 1.87 mg/g from rice by extraction with diethyl ether, ethyl acetate-benzene and diethyl ether. Large amounts of fairly pure rubratoxins A and B could be obtained by a combination of preparative TLC and column chromatography. JA

60

Patulin and citrinin synthesis by *Penicillium expansum*.

Ciegler, A.; Vesonder, R. F.; Jackson, L. K. *Abstracts of the Annual Meeting of the American Society for Microbiology* 76, 180 (1976) [En] [N. Regional Res. Lab., USDA, Peoria, Illinois, USA]

3 strains of *P. expansum*, isolated from mould-fermented meat, proved capable of producing patulin and citrinin concomitantly. Both toxins were isolated and crystallized after fungal growth on yeast extract-sucrose media. Both toxins caused teratogenic effects in chick embryo with malformations primarily in the extremities. Additional strains of *P. expansum* and taxonomically related species are being examined for their ability to produce the 2 toxins. AS

61

Two new trichothecenes from two strains of *Fusarium roseum*.

Ishii, K.; Mirocha, C. J.

Abstracts of Papers, American Chemical Society 170, AGFD 56 (1975) [En] [Dep. of Plant Path., Univ. of Minnesota, St. Paul, Minnesota 55101, USA]

62

Structure of safratoxin H, a metabolite of *Stachybotrys atra*. Application of proton and carbon-13 nuclear magnetic resonance.

Eppley, R. M.; Mazzola, E. P.; Highet, R. J.; Bailey, W. J.

Journal of Organic Chemistry 42 (2) 240-243 (1977) [16 ref. En] [Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

Safratoxin H was shown by spectroscopic studies to be a macrocyclic dilactone derivative of the sesquiterpene 12,13-epoxytrichothec-9-ene. It is most probably one of the causative agents of stachybotryotoxicosis, a food-borne disease which has affected both livestock and humans and presents a potentially serious public health hazard. AS

63

The analysis of food toxins by mass fragmentography.

Pareles, S. R.

Dissertation Abstracts International, B 36 (10) 4927; Order No. 76-7320 (1976) [En] [Rutgers

Univ., State Univ. of New Jersey, New Brunswick, New Jersey 08903, USA]

Mass fragmentography methods developed for sensitive confirmatory analyses of trace contaminants in foods utilize a DuPont 21-490 mass spectrometer. The methods were used for determining patulin in apple juice (sensitivity 1 part/billion), vinyl chloride in air (at levels of 0.9 pg/ml; the method can also be applied to foods), T-2 toxin in corn, and T-2 and HT-2 toxins in milk (at the 1.25 ppm level recovery of T-2 toxin is about 65% and the lower limit of detectability is 300 parts/billion). JA

64

Stability of patulin to sulfur dioxide and to yeast fermentation.

Burroughs, L. F.

Journal of the Association of Official Analytical Chemists 60 (1) 100-103 (1977) [5 ref. En]
[Long Ashton Res. Sta., Univ. of Bristol, Bristol BS18 9AF, UK]

The affinity of patulin for SO₂ is much less than was previously reported [FSTA (1971) 3 1C16] and is of little significance at the SO₂ concn. (<200 ppm) used in the processing of apple juice and cider. However, at concn. of 2000 ppm SO₂ and 15 ppm patulin, combination was 90% complete in 2 days. Removal of SO₂ liberated only part of the patulin, which suggests that 2 mechanisms are involved: one reversible (opening the hemiacetal ring) and one irreversible (SO₂ addition at the double bond). Tests with 2 yeasts used in English commercial cider making confirmed that patulin is effectively removed during yeast fermentation. AS

65

[Chlor-benzidine as a detector reagent for patulin in apple juice using thin layer chromatography.]

Chlor-Benzidin als

dünnschichtchromatographisches Nachweisreagenz für Patulin in Apfelsaft.

Meyer, R. A.

Nahrung 21 (1) 85-86 (1977) [8 ref. De]
[Bezirkshygieneinspektion Dresden, Inspektion Ernährungshygiene, German Democratic Republic]

A method is described for detection of patulin (now suspected to be carcinogenic). Apple juice is extracted with ethyl acetate, the organic phase dried, filtered, conc. under vacuum and purified on a kieselgel column. After elution with benzene:ethyl acetate (75:25) the eluate is conc. under vacuum and applied to a TLC plate of kieselgel with isopropyl ether:formic acid (88:12) as the mobile phase. The dried plate is chlorinated and sprayed with a solution of 50 mg benzidine in 85% formic acid. After 20-60 min the gold-green fluorescent stain is examined under long-wave UV light. ELC

66

[Determination of patulin in foodstuffs. I. Determination of patulin in apple juice.]

Patulinbestimmung in Lebensmitteln. I.

Patulinbestimmung in Apfelsaft.

Polzhofer, K.

Zeitschrift fuer Lebensmittel-Untersuchung und -Forschung 163 (3) 183-185 (1977) [13 ref. De, en] [Unilever Forschungsgesellschaft mbH, Behringstrasse 154, D-2000 Hamburg 50, Federal Republic of Germany]

For detn. of patulin in apple juice, a method was developed permitting detection of 40 µg patulin/kg juice. With additions of 120-200 µg patulin/kg, the recovery is 82-90%. After pre-purification of the crude extract by liquid-liquid extraction and column chromatography, patulin is determined thin layer chromatographically by reflectance measurement at 273 nm. AS

67

Estimation of the fungal toxins, zearalenone and aflatoxin, contaminating opaque maize in Zambia.

Lovelace, C. E. A.; Nyathi, C. B.

Journal of the Science of Food and Agriculture 28 (3) 288-292 (1977) [23 ref. En] [Dep. of Chem. & Biochem., Univ. of Zambia, PO Box 2379, Lusaka, Zambia]

The concn. of zearalenone and aflatoxin was estimated in Zambian home-brewed and commercial opaque maize beer. Levels of aflatoxin were negligible. Zearalenone was present at ≤4.6 mg/l. with a mean concn. of 0.92 mg/l. Zearalenone was detected in the maize and maize malt used in beer preparation and it was found to dissolve preferentially in the liquid fraction of the beer. The concn. was related to the district of maize growth. AS

68

Natural occurrence of alternariols in discolored pecans.

Schroeder, H. W.; Cole, R. J.

Journal of Agricultural and Food Chemistry 25 (1) 204-206 (1977) [7 ref. En] [USDA, College Station, Texas 77840, USA]

2 metabolites of *Alternaria* spp., alternariol monomethyl ether (AME) and alternariol (AOH), were extracted from discolored pecans (pickouts) from commercial shellers. AME and AOH isolated from an aqueous acetone extract of pecans were identified by comparison of their IR, UV, and mass spectra with spectra from authentic samples of AME and AOH; mp and TLC also confirmed the identifications. AS

69

Bean and other dried legume varieties as substrates for the production of mycotoxins.

Schindler, A. F.; Abadie, A. N.

Abstracts of the Annual Meeting of the American Society for Microbiology 76, 180 (1976) [En]

[FDA, Washington, DC, USA]

Previous studies have shown mycotoxin-producing species (*Aspergillus flavus*, *Asp. versicolor*, *Asp. ochraceus*, *Penicillium citrinum*, *P. cyclopium*, and *P. urticae*) in the mould profiles of dried beans. This finding stimulated the question as to whether beans would support extensive mould growth and mycotoxin production if exposed to moisture during storage. Dried legumes were inoculated with selected mycotoxin-producing mould spp. under conditions favourable for mould growth. After varying times of incubation the beans were chemically extracted, the extracts spotted on TLC plates and mycotoxins quantitatively determined. Pinto, black eye peas, split peas, Great Northern, navy, lentils, baby lima, garbanzo, cow peas, soybeans and pink kidney beans were found to be suitable, in varying degrees, as substrates for the production of aflatoxins B₁, G₁ and M₁ and sterigmatocystin. AS

70

Improved thin layer chromatographic method for the isolation and estimation of sterigmatocystin in grains.

Athnasios, A. K.; Kuhn, G. O.

Journal of the Association of Official Analytical Chemists 60 (1) 104-106 (1977) [11 ref. En] [Quaker Oats Co., 617 W. Main Street, Barrington, Illinois 60010, USA]

A modified TLC method has been developed in conjunction with the method of Stack and Rodricks [FSTA (1971) 3 8M870] which effectively separates sterigmatocystin from interfering materials and eliminates the time-consuming column chromatographic clean-up step. Initial extraction with acetonitrile-water (9 + 1) containing KCl is followed by partition of the extract first against hexane and then against CHCl₃. The CHCl₃ extract is evaporated and the residue is dissolved in benzene and applied directly to pre-coated high resolution TLC plates, which are developed in benzene-acetic acid (90 + 10). Visualization of the sterigmatocystin on TLC plates is enhanced by an AlCl₃ spray reagent, and concn. of sterigmatocystin as low as 50 µg/kg can be estimated by comparing fluorescence intensity against a pure sterigmatocystin standard. The method was applied to barley, white and yellow corn, oats, and wheat. Recoveries of added toxin in the range of 50-400 µg/kg ranged from 86.3% for yellow corn and oats to >96% for barley, wheat and white corn. AS

71

Recommended methods for ochratoxins A and B in barley.

International Union of Pure & Applied Chemistry, Applied Chemistry Division

Information Bulletin, International Union of Pure and Applied Chemistry, Technical Reports No. 14, 17pp. (1976) [2 ref. En] [FDA, Washington, DC, USA]

Because of the need for an IUPAC method for determining ochratoxins A and B in barley and on the basis of a collaborative study [FSTA (1973) 5 11M1421], the IUPAC Commission of Food Contaminants has approved the method of Nesheim et al. [FSTA (1973) 5 11M1420]. The method is described. RM

72

Secalonic acids D and F are toxic metabolites of *Aspergillus aculeatus*.

Anderson, R.; Büchi, G.; Kobbe, B.; Demain, A. L.

Journal of Organic Chemistry 42 (2) 352-353 (1977) [15 ref. En] [Dep. of Chem., Massachusetts Inst. of Tech., Cambridge, Massachusetts 02139, USA]

The chemical identification, preparation and biological activity of secalonic acids D and F, produced by *Asp. aculeatus* Fizuka grown on white corn, are reported. Both showed antimicrobial activity against *Bacillus megaterium*, secalonic acid F being somewhat less active than secalonic acid D. RM

73

Four new mycotoxins of *Aspergillus clavatus* related to tryptoquivaline.

Büchi, G.; Kin Chun Luk; Kobbe, B.; Townsend, J. M.

Journal of Organic Chemistry 42 (2) 244-246 (1977) [12 ref. En] [Dep. of Chem., Massachusetts Inst. of Tech., Cambridge, Massachusetts 02139, USA]

The hydroxylamine nortryptoquivaline and 3 secondary amines (deoxytryptoquivaline, deoxynortryptoquivaline and deoxynortryptoquivalone) were found to be toxic metabolites of *Asp. clavatus* (strain MIT-M-18) isolated from mould-infested rice obtained from a Thai household where a child had died of an unidentified toxicosis. These compounds were accompanied by 2 previously described tremor-producing agents (tryptoquivaline and nortryptoquivalone). None of the 4 first-named compounds had activity against the mycotoxin assay organism *Bacillus megaterium*. RM

74

Incidence of mycotoxic molds in domestic and imported cheeses.

Bullerman, L. B.

Abstracts of the Annual Meeting of the American Society for Microbiology 76, 190 (1976) [En] [Univ. of Nebraska, Lincoln, Nebraska, USA]

The natural mould flora of 75 samples each of domestic and imported cheeses was studied. Each sample was analysed for visible mould growth, isolation and classification of visible moulds, total viable mould plate counts, isolation and classification of representative moulds from plate counts, ability of mould isolates to produce known

mycotoxins and development of visible mould growth during simulated home storage of 1/2 of each sample. A total of 735 moulds was isolated from all sources, including 256 from domestic cheeses and 479 from imported cheeses. Of the total isolates 82% were classified as *Penicillium*, 4% *Aspergillus*, 4% *Cladosporium*, 1% *Fusarium* and 9% other genera. Preliminary screening of all isolates revealed no known mycotoxins in extracts of *Penicillium* cultures. Aflatoxins B₁ and B₂ were found in culture extracts of *A. flavus* isolates but neither ochratoxin A nor penicillic acid were detected in extracts of *A. ochraceus*. No other mycotoxins were found in culture extracts. Of the sample halves stored at 5°C for 5 wk, 23% did not develop visible mould growth, 15% developed scant (2-3 colonies), 22% moderate (covering one side) and 40% extensive (covering > 1 side to all sides) mould growth. All of the mould growth on the refrigerated cheese was of *Penicillium* species.

AS

75

Studies on the mycoflora of biltong.

Riet, W. B. van der

South African Food Review 3 (1) 105, 107, 109, 111 (1976) [33 ref. En]

Mould spoilage and formation of mycotoxins on biltong are a major problem in the South African meat industry. 20 samples of biltong, including 11 samples of stick biltong, 6 of packaged, sliced biltong and 3 of game biltong were examined for total mould counts, total yeast counts, NaCl content, moisture content, a_w , pH and production of aflatoxins on biltong in relation to a_w and atmospheric RH. Tabulated data are given. The mould and yeast counts respectively varied between < 10 and 1.9×10^5 /g and < 10 and 3.0 respectively. These counts were not related to the NaCl content, moisture content or a_w values. Approx. 55% of the mould isolates were members of the genus *Aspergillus* and 13% were from the genus *Penicillium*. The most frequently isolated yeasts were *Torulaspora hansenii*, *Candida zeylanoides* and *Trichosporon cutaneum*. Of a total of 26 strains of *Aspergillus flavus*, 16 were found to produce aflatoxins B₁ and B₂ on synthetic media; aflatoxin synthesis continued until mycelial growth was arrested at a_w 0.88. Growth as well as aflatoxin production occurred at RH 85% but not at RH 80%. Other mycotoxin producing fungi were also isolated. Toxin production can be avoided by hygienic manufacture, lowering the a_w to < 0.70 and the application of preservatives. GL

76

[Mycological flora of processed food products of plant origin.]

Osipyan, L. L.; Batikyan, A. G.

Biologicheskii Zhurnal Armenii 29 (1) 12-19

(1976) [9 ref. Ru, am] [Erevanskii

Gosudarstvennyi Univ., Kafedra Nizshikh Rastenii, Erevan, USSR]

A detailed description is given of 24 fungal species isolated in the Armenian SSR from food products of plant origin, e.g. dried or sterilized fruit, vegetables, jams, pickles, salted products. 3 species, namely *Mucor dimorphosporus*, *M. silvaticus*, and *Hyalodendron* sp., were hitherto unknown in the Armenian SSR. Of the 24 species, 9 belonged to genera capable of producing mycotoxins. STI

77

[Characteristics of microflora in food products originating from southwest Kazakhstan.]

Nikov, P. S.; Fadeeva, L. M.; Imankulova, S. K.; Kolesnikova, G. A.

Voprosy Pitaniya No. 2, 59-63 (1977) [10 ref.

Ru, en] [Kazakhskii Filial Inst. Pitaniya AMN SSSR, Alma-Ata, USSR]

The fungal microflora of a total of 317 samples of rice, millet, flour, pasta products, bread, meat, wheat and a few other foods, obtained from rural households in 2 regions of southwest Kazakhstan, was determined. The products had been stored 'in house' for periods ranging from several days to 1 yr. A total of 33 spp. (600 strains) of fungi was isolated. *Aspergillus* (16 spp.) predominated, but *Penicillium* was found in all samples. Other frequent organisms were *Rhizopus* and *Mucor* spp. The very high level of contamination with *Aspergillus* spores (up to 4400/g), particularly with toxigenic spp. (*A. flavus*, *A. fumigatus*, *A. niger*, *A. candidus*, *A. versicolor*), indicated a potential hazard from mycotoxicoses in the area. HBr

78

[Research into toxic metabolites of fungi.]

[Review]

Niku-Paavola, M.-L.; Nummi, M.

Kemia-Kemi 4 (4) 151-153 (1977) [18 ref. Fi,

en] [Valtion Teknillinen Tutkimuskeskus, Biotekniiikan Lab., Helsinki, Finland]

The structure, toxic effects and methods for analysis of mycotoxins are reviewed. Studies carried out in Finland of mycotoxins in grain are reported, the aim of the investigations being to develop a simple method for determining mycotoxins in grain and fodder. Results indicated that *Fusarium* and *Stachybotrys* spp. occur widely in grain and that most species form toxins under laboratory conditions. *Fusarium* spp. produce the following toxins: F2, T2, HT2, neosolaniol. A TLC method was developed for quantitatively determining these 4 toxins. [From En summ.] JA

79

Mycotoxicosis produced in mice by cultured products of an isolate of *Aspergillus ochraceus*.

Zimmermann, J. L.; Carlton, W. W.

Food and Cosmetics Toxicology 14 (6) 571-575

(1976) [40 ref. En] [Dep. of Vet. Microbiol. & Path., School of Vet. Med., Purdue Univ., W. Lafayette, Indiana 47907, USA]

Rice culture was fed at a dietary concn. of 5, 7.5, 9, 10, 25 and 50% to groups of 15 male and 15

female Swiss albino mice. Ground fungal mats of *A. ochraceus* were fed at a dietary concn. of 1, 2 or 3% to similar groups of 30 mice. Autopsy was performed on the mice that died and/or those killed when moribund or when the experiments were terminated after 3 wk of feeding. In groups fed the fungal-mat diet, body-wt. gains were markedly reduced and in those fed the highest concn. approx. 1/3 the mice died. Nearly all the mice fed the rice-culture diet had died by the third wk of feeding. The 3-wk LD₅₀ was about 7.0% for both sexes of mice fed the rice culture and 2.3% for those fed the fungal mats. Gross lesions with both types of diet included jaundice, greenish discoloration of the kidneys and focal necrosis in the liver. The cultures have been shown to be negative for aflatoxin, ochratoxin A, citrinin and penicillic acid. It seems likely that this strain of *A. ochraceus* produces an as yet unidentified toxin and that the toxin may be similar chemically to that produced by the isolates of *Penicillium viridicatum*. VJG

80

Isolation and toxicity of molds from foods stored in homes.

Torrey, G. S.; Marth, E. H.

Journal of Food Protection 40 (3) 187-190 (1977) [22 ref. En] [Dep. of Food Sci., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

Penicillia (49% of 155 isolates) and aspergilli (38%) were the predominant moulds isolated from food stored in private homes. Samples were taken from refrigerated and non-refrigerated food, and from refrigerator surfaces. Aflatoxin (9 isolates), kojic acid (3), ochratoxin A (3), penicillic acid (1), and patulin (1) were detected when culture extracts of isolates were screened for the presence of toxic mould metabolites. AS

81

Citrinin mycotoxicosis in the mouse.

Jordan, W. H.; Carlton, W. W.; Sansing, G. A. *Food and Cosmetics Toxicology* 15 (1) 29-34 (1977) [22 ref. En] [Dep. of Vet. Microbiol. & Pathol., School of Vet. Med., Purdue Univ., W. Lafayette, Indiana 47907, USA]

The acute toxicity of citrinin, a secondary metabolite produced by a number of fungal spp. belonging to the genera *Penicillium* and *Aspergillus*, was studied in the mouse, the mycotoxin being given by various routes and in 2 different solvents. Citrinin was mixed in a purified diet for feeding to mice, or was dissolved in NaOH or in equal parts of dimethylsulphoxide (DMSO) and 50% ethanol for administration by the ip, sc and oral routes. The death rate and pathological changes produced by a single dose of citrinin were not made more severe by multiple doses. Lesions were confirmed to the kidney. Citrinin dissolved in DMSO and 50% ethanol retained its biological activity when stored in a refrigerator for 1 month, but activity was lost when the citrinin solution was heated to 90°C for 10 min. VJG

82

Effect of aflatoxin B₁, ochratoxin A and rubratoxin B on infant rats.

Hayes, A. W.; Cain, J. A.; Moore, B. G.

Food and Cosmetics Toxicology 15 (1) 23-27 (1977) [24 ref. En] [Dep. of Pharm. & Toxicol., Univ. of Mississippi Med. Cent., Jackson, Mississippi 39216, USA]

Investigations were carried out to determine whether the neonate is more susceptible than the adult to each toxin and whether neonatal exposure leads to abnormal manifestations in the weanling or makes the animal more susceptible to a second mycotoxin given at the same time or several days later. Oral LD₅₀ values were determined in 24-h-old Sprague-Dawley rats for aflatoxin B₁ (1.36 mg/kg), ochratoxin A (3.90 mg/kg) and rubratoxin B (6.38 mg/kg). Compared with the oral LD₅₀ values in adults, the neonates showed an increased susceptibility to each mycotoxin. A synergistic response was not demonstrated when aflatoxin B₁ was given on day 1 followed by rubratoxin B on day 15 or in experiments using ochratoxin followed by rubratoxin. VJG

83

Patulin content of juice and wine produced from moldy grapes.

Scott, P. M.; Fuleki, T.; Harwig, J.

Journal of Agricultural and Food Chemistry 25 (2) 434-437 (1977) [21 ref. En] [Health Protection Branch, Health & Welfare Canada, Ottawa, Ontario K1A 0L2, Canada]

Patulin is a mycotoxin produced by a number of fungal spoilage organisms, some of which may be present on mouldy grapes. Juices and wines produced from Rauschling and Gamay grapes (mouldy at harvest) and from Concord and V.53263 grapes (mouldy after extended storage) were analysed for patulin. Patulin was present in the juices but was not detected in a partially fermented juice (Gamay) or the wines. *Penicillium* spp. were the predominant microflora of samples of the Rauschling grapes, from which were isolated strains of *P. expansum* that produced patulin and citrinin. AS

84

[Patulin in foods of plant origin. II. Several kinds of fruit and vegetables and fruit and vegetable products.] Patulin in Lebensmitteln pflanzlicher Herkunft. II. Verschiedene Obstarten, Gemüse und daraus hergestellte Produkte.

Frank, H. K.; Orth, R.; Figge, A.

Zeitschrift fuer Lebensmittel-Untersuchung und -Forschung 163 (2) 111-114 (1977) [7 ref. De, en] [Bundesforschungsanstalt für Ernährung, Engesserstr. 20, D-7500 Karlsruhe 1, Federal Republic of Germany]

Over a 3 yr period, patulin was observed in various fruits with spontaneous brown rot (bananas, pineapples, grapes, peaches, apricots), a strawberry-

rhubarb puree and a mouldy saw-tooth fruit juice. Mould growth and patulin formation were then studied in various fruits experimentally infected with *Penicillium expansum*, *P. urticae* and *Byssosclamyces nivea* and stored at room temp.; peaches, apricots, greengages, bananas and honeydew melons all showed both mould growth and patulin formation. Additionally, when 4 samples of sour cherry mother juice, 2 of plums and 1 of mirabelle were inoculated with *B. nivea* 561 (after removal of a non-patulin containing mould growth), they all contained ≤ 120 ppm patulin after 7 days at 22°C. The same strain also grew in home-made compotes of sweet cherry, plums, gooseberries, strawberries and rhubarb. 21-30°C was the optimum temp. for patulin formation, 15-37°C the temp. range. No formation was observed in jams containing $> 60\%$ sugar. [Continued in following abstr.] HBr

85

[Patulin in foods of plant origin. II. Several kinds of fruit and vegetables and fruit and vegetable products.] Patulin in Lebensmitteln pflanzlicher Herkunft. II. Verschiedene Obstsorten, Gemüse und daraus hergestellte Produkte.

Frank, H. K.; Orth, R.; Figge, A.

Zeitschrift fuer Lebensmittel-Untersuchung und -Forschung 163 (2) 111-114 (1977) [7 ref. De, en] [Bundesforschungsanstalt für Ernährung, Engesserstr. 20, D-7500 Karlsruhe 1, Federal Republic of Germany]

[Continued from preceding abstr.] In tests on vegetables, patulin formation was observed in red and green peppers, tomatoes, cucumbers, gherkins and carrots inoculated with *P. expansum*; *P. urticae* produced patulin only in tomatoes; and *B. nivea* did not grow on any of the vegetables. Patulin was formed in tomato juice (≤ 2.6 µg/g) and pulp (≤ 40 µg/g), but not in tomato ketchup, by *P. expansum* and *P. urticae*; *B. nivea* did not form patulin in any of these 3 products. In general, the mould strain was a major factor in patulin formation. The temp. is another major factor in that patulin formation must be considered possible in the 5-25°C range. [See FSTA (1977) 9 5J719 for part I.] HBr

86

[Mycotoxins and mycotoxicosis.] [Review] Arda, M.

Veteriner Hekimler Dernegi Dergisi 45 (3) 5-18 (1975) [78 ref. Tr] [Vet. Fac., Univ., Ankara, Turkey]

This review deals with various aspects of mycotoxins and mycotoxicosis, including occurrence of aflatoxins in milk and cheese, their resistance to pasteurization temp. (72-77°C) and milk drying temp. (130°C), and the effects, diagnosis, prevention and treatment of aflatoxicosis in animals, etc. ADL

87

[Determination of patulin in foodstuffs. II. Determination of patulin in tomatoes, pears, apples, cucumbers and plums.] Patulinbestimmung in Lebensmitteln. II. Patulinbestimmung in Tomaten, Birnen, Äpfeln, Gurken, Pflaumen. Polzhofer, K.

Zeitschrift fuer Lebensmittel-Untersuchung und -Forschung 163 (4) 272-273 (1977) [2 ref. De, en] [Unilever Forschungsgesellschaft mbH, Behringstrasse 154, D-2000 Hamburg 50, Federal Republic of Germany]

The limit of detn. of the method is 40 µg patulin/kg. At fortification levels of 100-500 µg patulin/kg, the recovery rate is 86-95%. After pre-purification of a crude extract of the food by column chromatography and liquid-liquid extraction, patulin is determined thin-layer chromatographically by reflectance measurement at 273 nm. [See FSTA (1977) 9 7H1202 for part I.] AS

88

The occurrence, pathogenicity, and toxicity of *Penicillium* species isolated from dent corn kernels. Caldwell, R. W.

Dissertation Abstracts International, B 37 (8) 3701: Order No. 77-1692 (1977) [En] [Purdue Univ., West Lafayette, Indiana 47907, USA]

89

The occurrence of 12,13-epoxytrichothecenes in seeds of safflower infected with *Fusarium oxysporum* f. sp. *carthami*.

Ghosal, S.; Chakrabarti, D. K.; Chaudhary, K. C. B.

Experientia 33 (5) 574-575 (1977) [11 ref. En] [Dep. of Pharmaceutics, Banaras Hindu Univ., Varanasi 5, Uttar Pradesh, India]

From the seeds of safflower (*Carthamus tinctorius* Linn.), infected with *Fusarium oxysporum* f. sp. *carthami*, 3 toxic compounds have been isolated in quantities sufficient to cause mycotoxicosis on prolonged ingestion. 2 of these have been identified as diacetoxyscirpenol and T-2 toxin, while the third one has also been partially characterized as a 12,13-epoxytrichothecene. Additionally, the incidence of secondary fusarial infection of healthy seeds due to contamination with the infected ones has been reported for the 1st time. AS

90

Production and biological activity of patulin and citrinin from *Penicillium expansum*.

Ciegler, A.; Vesonder, R. F.; Jackson, L. K.

Applied and Environmental Microbiology 33 (4) 1004-1006 (1977) [7 ref. En] [N. Regional Res. Cent., USDA, Peoria, Illinois 61604, USA]

P. expansum isolated from meat and apples produced both patulin and citrinin. Toxin identity

was confirmed by spectroscopic and physical methods. The mean lethal dose in chicken embryos was determined for toxins administered both singly and in various ratios. Simultaneous administration of mycotoxin combinations showed an additive effect. Both toxins were teratogenic in chicken embryos. AS

91

Investigations of mycotoxins relative to coffee. (In '7th International Colloquium on the Chemistry of Coffee' [see FSTA (1977) 9 10H1670].) [Lecture] Levi, C. P.; Trenk, H. L.; Yeransian, J. A. pp. 287-294 (1976) [22 ref. En] [General Foods Corp., White Plains, New York, USA]

Analytical procedures for detection of aflatoxin B₁, ochratoxin A and sterigmatocystin in green coffee, investigation of their natural occurrence in samples of green coffee beans from various sources, and studies of experimental production of these toxins in the laboratory under controlled conditions using green coffee as substrate are described. AL

92

Toxigenic fungi from decayed tissue of lychee fruits. Spalding, D. H.; Wells, J. M.

Abstracts of the Annual Meeting of the American Society for Microbiology 77, 259 (1977) [En] [USDA, Miami, Florida, USA]

A bioassay for fungal toxins based on intubation of test materials into the crops of day-old cockerels was used to screen fungal cultures isolated from decayed tissues of mature lychee (*Litchi chinensis* Sonn.) fruits. Chloroform extracts of 37 of 132 fungi grown on an artificial medium were toxic to cockerels. Toxigenic fungi in order of frequency were: *Fusarium* (24.3%), *Cladosporium* (21.6%), *Alternaria* (16.2%), *Asphaeria* (10.8%), *Colletotrichum* (10.8%), *Curvularia* (8.1%), *Phomopsis* (5.4%), and *Helminthosporium* (2.7%). These studies indicate that fungi associated with decays of lychee fruits can produce toxins in an artificial medium and warrant investigation of potential production during decay of fruits. AS

93

Natural occurrence of sterigmatocystin in in-shell pecans.

Schroeder, H. W.; Hein, H., Jr.

Canadian Journal of Microbiology 23 (5) 639-641 (1977) [11 ref. En, fr] [USDA, Oklahoma-Texas Area, PO Box ED, College Station, Texas 77840, USA]

Naturally occurring sterigmatocystin was detected (approx. 20 ppm on a single half kernel basis) in a sample of in-shell pecans purchased in Nov. 1975 and thought to originate from S. Georgia-N. Florida area. The predominant fungi isolated from the nuts were *Aspergillus flavus* (43%) and *A. glaucus* (35%), but not *A. versicolor*. Storage of further samples of pecans from the contaminated batch (at 25°C and 85% RH for 3 wk) failed to

produce detectable amounts of sterigmatocystin suggesting that only 1 kernel in the batch may have been contaminated. The need for development of more sensitive methods for detection of sterigmatocystin is stressed. MEG

94

Penicillic acid production in submerged culture. Ciegler, A.; Lindenfelser, L. A.

Abstracts of the Annual Meeting of the American Society for Microbiology 77, 248 (1977) [En] [N. Regional Res. Cent., USDA, Peoria, Illinois 61604, USA]

Penicillic acid (pa), a potential mycotoxin, has been reported in 'blue-eye' stored corn. Although this compound is not very toxic when administered alone, synergistic toxicity occurs in the presence of other mycotoxins. For detoxification studies, considerable quantities of pa were required. Static culture fermentation giving good yields of pa (1-2 g/l.) has been reported but the process is not amenable to scale-up; submerged culture production has not been noted. Numerous fungi were examined under various fermentation conditions in deep culture and pa yields up to 4 g/l. were obtained at 25°C with *Penicillium cyclopium* NRRL 1888 and with mannitol as a C source. Use of sugars such as maltose and lactose gave 2 g/l. Because of the high cost of pure sugars, whey alone was successfully substituted for the complete medium with yields of 3 g/l. However, attempts to produce pa on grains in a solid substrate fermenter under agitation were unsuccessful. AS

95

Incidence of mycotoxic molds in domestic and imported cured and smoked meats.

Bullerman, L. B.

Abstracts of the Annual Meeting of the American Society for Microbiology 77, 259 (1977) [En] [Univ. of Nebraska, Lincoln, Nebraska 68583, USA]

The mould flora of 86 samples of domestic and 85 samples of imported cured and smoked meats was studied. Each sample was analysed for: visible mould growth, isolation and classification of visible moulds, total viable mould plate counts, isolation and classification of representative moulds from plate counts, ability of mould isolates to produce known mycotoxins and development of visible mould growth during simulated storage of 1 of each sample. A total of 1038 was isolated from all sources, including 393 from domestic meats and 645 from imported meats. Of the total isolates, 68.1% were *Penicillium*, 2.4% *Aspergillus*, 4.9% *Cladosporium*, 5.8% *Alternaria*, 0.9% *Fusarium* and 17.9% various other genera. Potentially toxic spp. of moulds were found in the following amounts: *P. cyclopium* 8.5%, *P. viridicatum* 6.2%, *A. flavus*, 0.9% and *A. glaucus* 0.4%. Screening of mould isolates for mycotoxin production showed the presence of the following known mycotoxins in culture extracts: aflatoxins 0.5%, ochratoxin A 3.0%, patulin 1.5%,

penicillic acid 1.8% and citrinin 0.1%. No other known mycotoxins were found in culture extracts. Of the sample halves stored at 5°C for 6 wk, mould growth developed in the following amounts: 20% none, 15% scant (2-3 colonies), 16% moderate (covering one side) and 40% extensive (covering more than one to all sides). All of the mould growth on the stored meat was of *Penicillium* spp. AS

96

Balkan (endemic) nephropathy and foodborn ochratoxin A: preliminary results of a survey of foodstuffs.

Krogh, P.; Hald, B.; Plestina, R.; Ceovic, S. *Acta Pathologica et Microbiologica Scandinavica, B* 85 (3) 238-240 (1977) [10 ref. En] [Renal Lab., Dep. of Path., Rigshospitalet, DK-2100 Copenhagen O, Denmark]

The possible role of dietary ochratoxin A as a cause of Balkan endemic nephropathy is discussed. Ochratoxin A was determined in food samples from endemic and non-endemic areas (both near Slavonski Brod, Yugoslavia). Tables of results are given. Values for the proportion of food samples contaminated with ochratoxin in the endemic area were (number of samples studied, and the number found to be contaminated): maize, 10 and 2; wheat, 28 and 3; barley, 9 and 1; and pork, 12 and 1. In the non-endemic areas, 1 of 38 maize samples was contaminated; none of 12 wheat samples and 14 barley samples were contaminated. Pork from the non-endemic area was not tested. Ochratoxin A concn. in foods from the endemic area were ($\mu\text{g/kg}$): maize, 18 and 90; wheat, 12, 36 and 55; barley, 5; and pork, 5. The single contaminated maize sample from the non-endemic area contained 14 μg ochratoxin A/kg. AJDW

97

[Moulds and mycotoxins: methods of identification, prevention and elimination.] [Conference proceedings]

Italy, Societa Italiana di Microbiologia Applicata (SIMA)

Industrie Alimentari 16 (6) 67-141 (1977) [many ref. It]

Papers read at a Symposium held in Milan on March 16, 1977 under the auspices of the Italian Society of Applied Microbiology and organized by

Pool Bioanalysis Italiana are presented. They include: Detection techniques for moulds in foods: A review, by P. Camaschella (pp. 68-74, 66 ref.); Antimycotic treatment in some sections of the food industry, by G. Cirilli (pp. 74-76); Prevention of degradation of paints and varnishes used in the food industry, by A. Massara, C. Cantoni & M. A. Bianchi (pp. 77-82); Moulds and bakery products, by A. Alfieri (pp. 82-84); Prevention and elimination of fungal contamination in the bakery industry, by M. Campana (pp. 85-87); Moulds and

foods of animal origin: A review, by C. Cantoni, S. D'Aubert & P. Cattaneo (pp. 90-97, 50 ref.); Prevention of mould formation on meat products, by P. C. Moerman (pp. 98-100, 18 ref.); Detection of mycotoxins in feeds and foods: A review, by N. Fiussello (pp. 100-103, 17 ref.); Isolation and identification of toxic fungal strains, by J. Ceruti Scurti (pp. 104-106, 15 ref.); [Continued in following abstr.] HBr

98

[Moulds and mycotoxins: methods of identification, prevention and elimination.] [Conference proceedings]

Italy, Societa Italiano di Microbiologia Applicata (SIMA)

Industrie Alimentari 16 (6) 67-141 (1977) [many ref. It]

[Continued from preceding abstr.] Moulds and mycotoxins in Italian cheeses, by S. Carini & G. Cerutti (pp. 106-108, 3 ref.); Gezet, an antimycotic product for external treatment of cheese, by B. W. Jilly (pp. 109-111, 9 ref.); Antimycotic experiments in the Friuli cheese factory, by M. Costanzo (pp. 111-112); Mycotoxins in cheese, by J. J. Devoyod (pp. 112-114); Aflatoxins in oilseeds: Methods of identification and prevention, by R. Monacelli (pp. 114-116); Physico-chemical detn. of mycotoxins, particularly aflatoxins, by M. Jemmali (pp. 117-119); Analysis and detn. of mycotoxins in foods, by P. Lafont & J. Lafont (pp. 119-123, 36 ref.); Use of new degradable fungicides in the prevention and elimination of mould contamination, by R. R. Vidal y Plana, P. Senin, F. Makovec & C. Vidali (pp. 129-131, 3 ref.); Moulds and their metabolites in cereals for the brewing industry, by F. Collavo (pp. 132-134, 5 ref.); and Food mycotoxicosis, by C. Bessler, J. Amici & V. A. di Leo (pp. 135-141). HBr

99

Aflatoxin and zearalenone occurrence in dry-milled corn products.

Stoloff, L.; Dalrymple, B.

Journal of the Association of Official Analytical Chemists 60 (3) 579-582 (1977) [15 ref. En]

[Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

82 corn dry-milling establishments in 20 States in the USA were surveyed concerning control practices for preventing the use of corn contaminated with aflatoxin or zearalenone. Prime products and by-products from each establishment were analysed for these mycotoxins to determine whether a correlation exists between control practices and product contamination. No zearalenone was detected in any product; there was little awareness of the potential for contamination with this mycotoxin. No correlation was found between control practices and aflatoxin contamination encountered, but there was a positive correlation between aflatoxin

contamination and the geographical source of the corn. Reported experimental findings [see FSTA (1975) 7 8M959] in regard to the distribution of aflatoxin between prime product and by-product were generally corroborated. AS

100

Incidence of toxic and other mold species and genera in soybeans.

Mislivec, P. B.; Bruce, V. R.

Journal of Food Protection 40 (5) 309-312 (1977) [23 ref. En] [Div. of Microbiol., FDA, Washington, DC 20204, USA]

The mould flora of 385 unprocessed soybean samples was determined before and after surface disinfection of the beans with 5% NaOCl. Moulds were detected in 99.4% of the 19 250 non-disinfected soybeans examined and in 52.8% of the 19 250 surface-disinfected soybeans examined, indicating that contamination was primarily at the surface, although internal invasion also was substantial. The mould flora, both before and after surface disinfection, was dominated by spp. of the *Aspergillus glaucus* group, *A. flavus*, *A. candidus*, *Penicillium cyclopium*, plus spp. of *Alternaria* and *Cladosporium*. The toxicogenic spp. *A. flavus*, *A. nidulans*, *A. ochraceus*, *A. versicolor*, *Penicillium citrinum*, *P. cyclopium* and *P. viridicatum* were encountered regularly in non-surface-disinfected soybeans. Except for *A. flavus* and *P. cyclopium*, the occurrence of toxicogenic spp. in surface-disinfected soybeans was sporadic. The toxicogenic spp. *A. melleus*, *P. expansum* and *P. urticae* were encountered occasionally, but only in non-surface-disinfected soybeans. *P. chrysogenum*, the penicillin-producing organism, was encountered regularly in non-surface-disinfected soybeans, but less frequently in disinfected soybeans. AS

101

Study of conditions for production of roquefortine and other metabolites of *Penicillium roqueforti*.

Scott, P. M.; Kennedy, B. P. C.; Harwig, J.; Blanchfield, B. J.

Applied and Environmental Microbiology 33 (2) 249-253 (1977) [16 ref. En] [Food Directorate, Health Protection Branch, Health & Welfare Canada, Ottawa K1A 0L2, Canada]

4 strains of *P. roqueforti* Thom, isolated from Stilton, Danish blue, Finnish blue and Gorgonzola cheeses, were examined for roquefortine, isofumigaclavine A and PR toxin production in a medium containing 15% sucrose and 2% yeast extract. All 4 strains produced roquefortine and PR toxin, but the Danish blue strain did not produce isofumigaclavine A under these conditions. At 25°C max. yield of roquefortine from the Finnish blue strain was approx. 100 mg/l. after 16 days, and max. PR toxin production was 770 mg/l. after 21 days. After 49 days at 15°C yields of roquefortine and PR toxin were only 60-70% of max. yields

obtained at 25°C; yields of isofumigaclavine A were 1 mg/mycelium mat (vs. 0.5-0.7 mg/mycelium mat at 25°C). [See also FSTA (1976) 8 12P2309.] MEG

102

[Effect of cultural conditions on production of a mycotoxin by strains of *Penicillium roqueforti*.]

Piva, M.-T.; Guiraud, J.; Crouzet, J.; Galzy, P.

Lait 56 (557) 397-406 (1976) [2 ref. Fr, en] [Lab. de Biochimie Appliquée, Univ. des Sci. & Tech du Languedoc, 34060 Montpellier Cedex, France]

Production of PR toxin by strains of *P. roqueforti* occurs only under specific cultural conditions, which are not those used in cheesemaking. Selection of a *P. roqueforti* strain that does not produce PR toxin is suggested as an additional safeguard. MEG

103

Analysis of ochratoxin B alone and in the presence of ochratoxin A, using carboxypeptidase A.

Hult, K.; Hökby, E.; Gatenbeck, S.

Applied and Environmental Microbiology 33 (6) 1275-1277 (1977) [3 ref. En] [Dep. of Pure & Applied Biochem., Royal Inst. of Tech., S 100 44 Stockholm 70, Sweden]

A method is described for ochratoxin B analysis, which is adapted from the earlier described method of ochratoxin A analysis, using carboxypeptidase A [see FSTA (1976) 8 7M905]. The fluorescence spectra of ochratoxins A and B coincide too much to allow direct discrimination of the 2 compounds. A method using the differences in kinetic parameters of the enzymic hydrolysis of the 2 compounds is suggested for the analysis of mixtures of the ochratoxins. AS

104

High-pressure liquid chromatographic method for detection and resolution of rubratoxin, aflatoxin, and other mycotoxins.

Engstrom, G. W.; Richard, J. L.; Cysewski, S. J.

Journal of Agricultural and Food Chemistry 25 (4) 833-836 (1977) [42 ref. En] [Nat. Anim. Disease Cent., Vet. Res. Service, USDA, Ames, Iowa 50010, USA]

A high-pressure liquid chromatography system (HPLC) was developed to resolve a mixture of 7 mycotoxins (aflatoxin B₁, aflatoxin G₁, ochratoxin A, zearalenone, rubratoxin B, patulin and penicillic acid). This HPLC system includes a new UV detector, a reverse phase μ Bondapak/C₁₈ column and a solvent system of acetonitrile/water/glacial acetic acid (55:45:2 or 45:55:2, v/v/v). Detection limits were as low as 5 ng rubratoxin B, 1 ng zearalenone, 0.04 ng ochratoxin A (254 nm), and 1 ng aflatoxin B₁ or G₁ (365 nm). This system also resolved trichothecin from the other 6 mycotoxins in the absence of ochratoxin A, roseotoxin B from the other 6 mycotoxins in the absence of rubratoxin B, and sterigmatocystin from the other 6 mycotoxins in the absence of zearalenone. AS

105

[Harmful chemicals in foods.]

Lempka, A.

Zeszyty Naukowe Akademia Ekonomiczna w Poznaniu Seria I, Prace z Zakresu

Towaroznawstwa i Chemii No. 58, 17-22 (1974)

[Pl] [Akad. Ekonomiczna, Poznan, Poland]

A general discussion is given of the major sources of harmful chemicals (soil, water, atmosphere); the major inorganic harmful chemicals (heavy metals, S-containing compounds); the major natural harmful substances (mycotoxins); and the major synthesized harmful compounds (pesticides, detergents). STI

106

[Contamination of foods with mycotoxin-producing fungi.] [Review]

Ichinoe, M.; Kurata, H.

Journal of the Food Hygienic Society of Japan[*Shokuhin Eiseigaku Zasshi*] 17 (5) 337-344

(1976) [55 ref. Ja] [Nat. Inst. Hygienic Sci.,

Kamiyoga, I-chome, Setagaya-ku, Tokyo, Japan]

Recent work on mycotoxins and mycotoxin-producing fungi is reviewed with respect to contamination of domestic (Japanese) and imported foods. The potential production of aflatoxin, sterigmatocystin, ochratoxin, penicillic acid and patulin was investigated for various fungi. TM

107

Occurrence and distribution of mycotoxic flora in some Nigerian foods.

Adekunle, A. A.; Ayeni, O.

Egyptian Journal of Microbiology 9 (1/2) 85-95

(1974 publ. 1976) [12 ref. En, ar] [Dep. of

Biochem., Univ. of Ibadan, Ibadan, Nigeria]

The fungal contamination of 15 Nigerian foods, purchased from 4 district markets, was examined. The most frequently occurring genera were *Cladosporium* (29.4% of total), *Aspergillus* (23.2%), *Penicillium* (18.8%) and *Fusarium* (16.7%). The sp. distribution of flora are tabulated, as are the % flora distribution for each food type and the % occurrence of fungal spp. in each food type. The most heavily contaminated foods were maize, groundnut, gari and millet, but other foods were only marginally less contaminated. DIH

108

[Mycotoxins in dairy products.] [Review]

Moreau, C.

Lait 56 (555/556) 286-303 (1976) [80 ref. Fr,

en] [Lab. de Biol. Vegetale et de Microbiol.,

CNRS, Univ. de Bretagne Occidentale, 29279

Brest Cedex, France]

This review considers the transfer of aflatoxins from fodder into milk, and the formation of mycotoxins in dairy products (such as dried milk, cheese and butter) due to fungal contamination.

MEG

1

The ochratoxins and other related compounds.

[Lecture]

Nesheim, S.

Advances in Chemistry Series 149, 276-295

(1976) [152 ref. En] [Div. of Chem. & Physics, FDA, 200 C Street, SW, Washington, DC 20204, USA]

The ochratoxins are toxic metabolites elaborated by several spp. of *Aspergillus ochraceus* as well as by *Penicillium viridicatum*. The discovery, chemistry, history, sources, occurrence, toxicology, and fate in foods and feeds of these metabolites are reviewed. Emphasized are the analytical methods for detection and estimation of ochratoxins with reference to their applicability in grains, nuts, beer, animal tissues, etc. Similarities and differences in sampling procedures, extraction methods and solvents, extract purification, toxin detection and estimation, and chemical and biological techniques of confirmation of identity are described. Other metabolites which interfere with current methods are listed. Suggestions to direct further efforts in developing analytical methods for ochratoxins are proposed. [See *FSTA* (1977) 9 1C16.] AS

2

A rapid screening method for the aflatoxins and ochratoxin A.

Holaday, C. E.

Journal of the American Oil Chemists' Society 53

(9) 603-605 (1976) [6 ref. En] [Nat. Peanut Res. Lab., PO Box 637, Forrester Drive, Dawson, Georgia 31742, USA]

A rapid, economical minicolumn procedure for screening aflatoxins and ochratoxin A in a wide range of products (wheat, barley, sorghum, corn, rice, rye and peanuts) is presented. The technique includes high speed blending of the sample with aqueous methanol, purification of the extract with a solution of zinc sulphate and phosphotungstic acid, partitioning in benzene, and minicolumn chromatography. Sensitivities of 4 parts/billion (ppb) for the aflatoxins and 20 ppb for ochratoxin A could be achieved; and the simplicity of the method, which includes the use of disposable plastics and glass items, makes the method practical for field or in-plant applications. AS

3

[Ochratoxin in barley and oat products.]

Josefsson, E.

Var Foeda 28 (8) 206-209 (1976) [12 ref. Sv, en] [Statens Livsmedelsverk, 751 26 Uppsala, Sweden]

110 samples of barley and barley products (whole grain, flour, flakes, etc.) and 79 samples of oats and oat products were analysed for ochratoxin A. Only 2 samples of oat products contained ochratoxin A (both at concn. <5 µg/kg). 5 samples of barley products contained ochratoxin A at concn. of <5 (2 samples), 8, 9 and 11 µg/kg. AJDW

4

[Occurrence of ochratoxins in raw materials and their determination.] [Review]

Chelkowski, J.; Golinski, P.; Kubiak, A.

Przemysł Spożywczy 30 (10) 367-369 (1976) [21 ref. Pl, ru, en, fr, de] [Inst. Tech. Żywności Pochodzenia Roslinnego, AR, Poznań, Poland]

This review includes results (graphically presented) of tests with standard preparations of A, B and C ochratoxins obtained from the US FDA, in which Adsorbosil 1 (Applied Science Laboratory), Merck G silica gel, and POCh Gliwice (Poland) large-pore gel were compared for detn. of the ochratoxins by TLC and spot fluorescence. Preference is given to Adsorbosil 1 because of best separation effect. The detection limit was at the 10 µg/spot level. SKK

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FAB 50

MYCOTOXINS IN FOODS (EXCLUDING AFLATOXINS & MICROBIAL TOXINS)

SELECTED FROM VOLUME 8

FOOD SCIENCE AND TECHNOLOGY ABSTRACTS

under the direction of

Commonwealth Agricultural Bureaux, Farnham Royal, Bucks; Institut für Dokumentationswesen, Frankfurt am Main; Institute of Food Technologists, Chicago; Centrum voor Landbouwpublikaties en Landbouwdocumentatie (Pudoc), Wageningen; Zentralstelle für maschinelle Dokumentation—Frankfurt am Main.

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H. BROOKES
ASSISTANT EDITOR

1

[Biological testing using the brine shrimp. I. Sensitivity of the brine shrimp to mycotoxins.]

Tanaka, K.; Minamisawa, M.; Manabe, M.; Matuura, S.

Report of the National Food Research Institute [Shokuryo Kenkyusho Kenkyu Hokoku] No. 30, 43-48 (1975) [11 ref. Ja, en]

Studies on the sensitivity of the brine shrimp (*Artemia salina*) to various mycotoxins (T-2 toxin, sterigmatocystin, diacetoxyscirpenol, aflatoxins, fusarenon-x, rubratoxin-B, kojic acid, ochratoxin A, aspergillie acid, patulin, penicillic acids, citrinin, ruglosin) are described. The results are discussed with reference to the potential use of this organism for biological screening for mycotoxins. [From En summ.] AJDW

2

Toxigenic fungi in food.

Davis, N. D.; Wagener, R. E.; Dalby, D. K.; Morgan-Jones, G.; Diener, U. L.

Applied Microbiology 30 (1) 159-161 (1975) [12 ref. En] [Dept. of Bot. and Microbiol., Auburn Univ., Agric. Expt. Sta., Auburn, Alabama 36830, USA]

45 fungal isolates from mouldy supermarket foods were tested for toxicity to brine shrimp, and 22 of these isolates were subsequently tested for toxicity to chicken embryos. Highly toxigenic fungi were *Cladosporium sphaerospermum* from a bakery product, *Fusarium oxysporum* from carrots, *F. solani* from cabbage, *Aspergillus niger* and *Penicillium corylophilum* from bread, *P. cyclopium* and *P. herquei* from corn meal, *P. lanosum* from onions, *P. steckii* from chocolate syrup, *Penicillium* sp. from jelly, and *Rhizopus nigricans* isolates from sweet potato, applesauce, and strawberries. Approximately one-third of the fungal cultures were moderately to highly toxigenic to brine shrimp and chicken embryos, while several additional cultures were slightly toxigenic. AS

3

Mycotoxins.

Austwick, P. K. C.

British Medical Bulletin 31 (3) 222-229 (1975) [91 ref. En] [Nuffield Inst. of Comparative Med., Zoological Society of London, London, UK]

Problems of mycotoxins occurring in foods are discussed, with reference to: the chemical nature of mycotoxins; factors influencing formation of mycotoxins in foods; toxic effects of mycotoxins (carcinogenicity, teratogenicity, and effects on liver, kidneys, alimentary tract, skin, nervous system, muscle tissue, respiratory tract and reproductive tract); toxic phytoalexins; and detection and control measures. Tables are given of names, causative organisms, toxic effects and incidence of numerous mycotoxins. AJDW

4

Ochratoxins. [Review]

Applegate, K. L.; Chipley, J. R.

Advances in Applied Microbiology 16, 97-109 (1973) [66 ref. En] [Dept. of Poultry Sci., Ohio St. Univ., Columbus, Ohio, USA]

The subject is reviewed under the following headings: fungi producing ochratoxins; occurrence of ochratoxins and toxin-producing organisms; factors affecting ochratoxin production; structural and biochemical properties; extraction and detection; and biological effects. Mention is made of the occurrence of ochratoxins in foods. JA

5

The new world of mycotoxins - animal and human health. [Review]

Newberne, P. M.

Clinical Toxicology 7 (2) 161-177 (1974) [59 ref. En] [Dept. of Nutr. & Food Sci., Massachusetts Inst. of Tech., Cambridge, Massachusetts, USA]

This review discusses salient features of the more commonly recognized mycotoxicoses in man and animals. Human diseases in which mycotoxins have been implicated are ergotism, alimentary toxic aleukia (ATA), fusarium toxicity, Kashin-Beck disease, celery harvesters' disease (caused by *Sclerotinia sclerotiorum*), cardiac beri-beri (or Shoshin-kakke), cirrhosis in infants, Reye's syndrome (or Udorn encephalopathy), hepatitis in infants, and the yellow rice syndrome. JA

6

[Various aspects of mycotoxicoses attributable to *Fusarium* spp.]

Piana, G.; Piva, G.

Rivista di Zootecnia e Veterinaria No. 3, 221-232 (1975) [65 ref. It] [Istituto di Zootecnia e Sci. della Nutr., Fac. di Agraria, Univ. Cattolica del Sacro Cuore, Piacenza, Italy]

The formation and toxicity of mycotoxins produced by *Fusarium* spp. are discussed, with special reference to zearalenone and the trichothene-group toxins. Possibilities for control of mycotoxin formation in foods and feeds are briefly discussed, together with methods for detection of mycotoxins. AJDW

7

High-pressure liquid chromatographic method for the determination of patulin in apple butter.

Ware, G. M.

Journal of the Association of Official Analytical Chemists 58 (4) 754-756 (1975) [12 ref. En] [Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

Patulin is extracted from apple butter samples with ethyl acetate and the extract is cleaned up on a silica gel column, using benzene-ethyl acetate (75 + 25) as the eluant. High-pressure liquid chromatography, using a 25 cm Zorbax-Sil column, isooctane-ethyl ether-acetic acid (750 + 250 +

0.5) as the mobile solvent, and a 254 nm UV detector, is used for the determinative step. Under these conditions, patulin is eluted before 5-hydroxymethylfurfural, a component of apple butter which interferes with other liquid chromatographic and TLC methods. Recoveries of patulin added at levels of 34.6, 138.4, and 276.8 µg/kg ranged from 89.0 to 112.1%. AS

8

Emodin, a toxic metabolite of *Aspergillus wentii* isolated from weevil-damaged chestnuts.

Wells, J. M.; Cole, R. J.; Kirksey, J. W.

Applied Microbiology 30 (1) 26-28 (1975) [17 ref. En] [Southeastern Fruit & Tree Nut Res. Sta., USDA, Byron, Georgia 31008, USA]

A diarrheagenic toxin from culture extracts of *Aspergillus wentii* Wehmer isolated from weevil-damaged Chinese chestnuts was identified as emodin (2-methyl-4,5,7-trihydroxyanthraquinone). The orange-red crystalline toxin (mp 255-257°C) showed UV absorption maxima in ethyl alcohol at 223, 250, 267, 290 and 442 nm, and IR absorption maxima at 3400 cm⁻¹ (OH), 1635, and 1625 cm⁻¹. Chemical shifts and coupling constants of the proton magnetic resonance spectra of the *A. wentii* toxin and of authentic emodin agreed. Mean lethal dose of emodin orally administered to 1-day-old DeKalb cockerels was 3.7 mg/kg. AS

9

[*Fusarium* spp. and their mycotoxins in cereals.]

Sottini, E.

Rivista di Zootecnia e Veterinaria No. 3, 207-219 (1975) [39 ref. It] [Istituto di Zootecnica, Univ. di Firenze, Florence, Italy]

Aspects considered in this review on mycotoxin formation by *Fusarium* spp. on cereals include: *Fusarium* spp. and other fungi on cereals in the field and in storage; formation of free fatty acids in cereals by fungal lipases; toxins formed by *Fusarium* spp. (sporofusariogenin, zearalenone, diacetoxyscirpenol, T-2 toxin, fusarenone, fusarenone-X, nivalenol); and effects of strain, temp., moisture content of the substrate and interaction with other microorganisms on formation of mycotoxins by *Fusarium* spp. AJDW

10

[Pimaricin and cheese moulds.]

Anon.

Technicien du Lait April, 5-9, 11-13, 15 (1975) [Fr]

Control of mould formation and consequent prevention of mycotoxin production in cheese, particularly by the use of pimaricin, is discussed. Treatment of cheeses in practice, use of pimaricin-treated polyvinyl acetate for wrapping cheeses, and penetration of pimaricin from the wrapping into the cheese are considered in the light of studies carried out in the Netherlands 15-20 years ago. CDP

11

[Occurrence, growth and toxin formation of moulds in foods.] [Review]

Northolt, M. D.; Schothorst, M. van; Soentoro, P. S. S.

Voedingsmiddelentechnologie 8 (13) 14, 15, 18, 19 (1975) [32 ref. Nl] [Rijks Inst. voor de Volksgezondheid, Postbus 1, Bilthoven, Netherlands]

Aspects considered in this review on growth and toxin formation by moulds in foods include: toxigenic mould spp., and the toxins produced; the relation between mycelial growth and toxin formation; effects of temp. and water activity on growth and toxin formation; effect of O₂ concn.; effects of the substrate; and effects of interaction with other microorganisms. AJDW

12

[Natural mycotoxin contaminants in agricultural products.] [Review]

Jemmali, M.

Bulletin des Anciens Eleves de l'Ecole Francaise de Meunerie No. 267, 131-140 (1975) [37 ref. Fr] [Sta. de Biochimie et Physicochimie des Cereales, Service des Mycotoxines, 16 Rue Nicolas-Fortin, 75013 Paris, France]

In this review the problems associated with contamination of foods by moulds are discussed under the headings: origins and type of fungal contamination; physical, chemical and biological factors influencing fungal growth; biochemical process occurring in products as a result of fungal growth; and production of mycotoxins and their pathological effects in man and animals. MEG

13

Methods for the detection of trichothecenes.

Eppley, R. M.

Journal of the Association of Official Analytical Chemists 58 (5) 906-908 (1975) [13 ref. En] [Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

Both biological and chemical methods for detection of various trichothecenes are reviewed. Some of the bioassay techniques in use for the detection of the various trichothecenes include the rabbit dermal toxicity test, cytotoxicity, and inhibition of protein synthesis tests; these are highly sensitive but lack specificity. The sensitivity of these tests for the T-2 toxin are 0.005 µg for rabbit skin toxicity, 0.03 µg/ml for inhibition of protein synthesis in rabbit reticulocytes, and <1 µg/ml for cytotoxicity to human karyoblast cells. In the present state of development of the chemical assay methods, TLC and GLC are specific for various trichothecenes but lack sensitivity. The lower detection limit of the trichothecenes on thin layer plates varies from 0.2 to 2-3 µg/spot while GLC has a reported sensitivity of approx. 0.05 µg/injection. AS

14

The effect of Botran on fascicle production by species of *Penicillium*.

Mislivec, P. B.

Mycologia 67 (1) 194-198 (1975) [6 ref. En] [Div. of Microbiol., FDA, US Dep. of Health, Education and Welfare, Washington, DC 20204, USA]

The production of diagnostic fascicles by *Penicillium* spp. infesting stored grain was enhanced by adding 20 ppm of Botran (2,6-dichloro-4-nitroaniline) to agar substrates. Routine use of 10-20 ppm Botran in isolation media during analysis of foodstuffs for the presence of mycotoxin and other moulds is recommended. RM

15

The significance of mycotoxins in foods. [Lecture]

Jarvis, B.

IFST Proceedings 8 (2) 88-92 (1975) [9 ref. En] [Leatherhead Food RA, Randalls Road, Leatherhead, Surrey, KT22 7RY, UK]

Occurrence of mycotoxins in foods is reviewed. Numerous spp. of microfungi produce toxic metabolites of diverse chemical constitution; systematic classification is not possible on either a chemical or a toxicological basis. Apart from the aflatoxins, little is known of their possible effects on man; legislative standards introduced by several countries for control of aflatoxins, ochratoxin A, rubratoxin, citrinin, penicillic acid, zearalenone and patulin are discussed with reference to mould spp. involved, food source (mainly cereals and oilseeds), chemical constitution and potential importance to man. The major risk is associated with contamination of primary products (cereals, nuts, oilseeds, dried fruits) and subsequent fungal growth during storage, particularly after wet harvests. There is little evidence of a serious hazard to human health from mould spoilage of manufactured foods or from mould fermented foods (blue cheese, salami); mould enzyme preparations for food use appear to be quite safe. ELC

16

[Effect of a *Fusarium* toxin on the germination of barley.] Der Einfluss eines *Fusarium*-Toxins auf die Gersten-Vermälzung.

Nummi, M.; Niku-Paavola, M.-L.; Enari, T.-M. *Brauwissenschaft* 28 (5) 130-133 (1975) [8 ref. De, en, fr, es] [St. Tech. Forschungszentrum, Biotech. Lab., Postfach 192, SF-00121, Helsinki 12, Finland]

Studies on the effect of epoxytrichothene (produced by *Fusarium tricinctum*, which commonly grows on cereals) on the germination and malting of barley are described. Treatment with epoxytrichothene inhibited germination, and retarded root and leaf growth; it also inhibited α -amylase biosynthesis in the aleurone. This inhibition of α -amylase formation was partial in intact grain, but total in grain from which the embryo had been separated. The inhibitory activity

of epoxytrichothene increased with increasing concn. It is planned to develop a method for detn. of *Fusarium* toxins, on the basis of these investigations. TUB-IGB

17

Patulin production in apples stored in a controlled atmosphere.

Lovett, J.; Thompson, R. G., Jr.; Boutin, B. K. *Journal of the Association of Official Analytical Chemists* 58 (5) 912-914 (1975) [5 ref. En] [Div. of Microbiol., FDA, 1090 Tusculum Avenue, Cincinnati, Ohio 45226, USA]

Red Delicious apples were inoculated with *Penicillium expansum* NRRL 973 or *P. expansum* 1071 (fresh apple isolate), and incubated in air at 33°F and in a controlled atm. of 1% CO₂, 3% O₂, and 96% N₂ at 33°F. Both fungal strains produced the carcinogen, patulin, in the air-incubated lots, but only the freshly isolated strain (1071) produced detectable patulin in controlled atm. lots. TLC was used to assay ethyl acetate extracts of juice pressed from blended apple tissue. It was concluded that naturally occurring *P. expansum* strains are capable of producing significant levels of patulin in apples stored from 3 to 6 months under controlled atm. conditions. AS

18

Trimming as a means of removing patulin from fungus-rotted apples.

Lovett, J.; Thompson, R. G., Jr.; Boutin, B. K. *Journal of the Association of Official Analytical Chemists* 58 (5) 909-911 (1975) [12 ref. En] [Div. of Microbiol., FDA, 1090 Tusculum Avenue, Cincinnati, Ohio 45226, USA]

Penicillium expansum 1071, 1172, NRLL 973, and *Penicillium patulum* ATCC 24550 were inoculated into Red Delicious, Golden Delicious, and McIntosh apples. The decayed tissue was trimmed from the sound tissue, each fraction was weighed, and the patulin concn. in the juice was assayed by TLC. The quantity of patulin in the whole apples and in decayed tissues was calculated and these values were used to determine the total patulin % removed by trimming. The patulin content ranged from 140 to 4880 µg/apple. Trimming removed 93-99% of the total patulin, regardless of incubation temp., fungus strain, or apple var. Trimming of defective tissue from fungus-rotted apples could substantially reduce the patulin concn. AS

19

Mycotoxins in hot spots in grains. I. Aflatoxin and zearalenone occurrence in stored corn.

Shotwell, O. L.; Goulden, M. L.; Bothast, R. J.; Hesseltine, C. W. *Cereal Chemistry* 52 (5) 687-697 (1975) [11 ref. En] [N. Regional Res. Lab., Peoria, Illinois 61604, USA]

A hot spot that developed *Aspergillus flavus* growth in a bin of corn in central Illinois during warm weather was investigated for mycotoxins. High levels of aflatoxin (1000-1700 ppb

(parts/billion)) were detected in samples collected near the centre of the hot spot that was defined by visible *Asp. flavus* sporulation. The location of the hot spot relative to an open window indicated the moisture necessary for mould growth, and aflatoxin formation could have come from rains blown through the window. Corn collected at all depths from 7 locations and probe samples taken under the hot spot were assayed for aflatoxin and zearalenone. Aflatoxin was not detected in samples collected furthest from the window. Zearalenone was detected in some of the samples collected, but it was not confined to any one part of the bin. The corn had been in the field an unusually long time before harvest because of cold, wet weather. Individual kernels selected from locations likely to contain aflatoxin and zearalenone were assayed for mycotoxins. Even in kernels connected with *Asp. flavus* mycelia, aflatoxin-free kernels occurred adjacent to highly contaminated kernels. Of 140 kernels analysed for both aflatoxin and zearalenone, 16 contained aflatoxin (260-38 000 ppb B₁ + B₂) and 12 had zearalenone (9000-1 700 000 ppb). In no kernel were both aflatoxin and zearalenone detected. AS

20

[Detection and quantitative determination of *Fusarium* T-2 toxin by a microbiological method.] Teren, J.; Ferenczy, F.

Elelmiszervizsgalati Közlemények 20 (5/6) 267-274 (1974) [9 ref. Hu, ru, de, en] [Megyei Elelmiszerezellenorzo es Vegyvizsgalo Intezet, Szeged, Hungary]

After screening a wide variety of microorganisms, a colourless alga (*Prototheca wickerhamii*) was chosen as test organism because of its sensitivity to T-2 toxin. When determining the toxin in cereals and feeds by the standard agar-diffusion method, the detection limit is 0.1 µg toxin/disk. When combined with a preparative TLC step, the new method is suitable for investigation of foods as well as cereals and feeds. A rapid procedure is described, combining TLC and the microbiological method, for semi-quantitative determination of the toxin in the range 0.1-2.5 µg/spot. IF

21

Toxigenic *Aspergillus* and *Penicillium* isolates from weevil-damaged chestnuts.

Wells, J. M.; Payne, J. A.

Applied Microbiology 30 (4) 536-540 (1975) [17 ref. En] [Southeastern Fruit & Tree Nut Res. Sta., Byron, Georgia 31008, USA]

Aspergillus and *Penicillium* were among the most common genera of fungi isolated on malt-salt agar from weevil-damaged Chinese chestnut kernels (16.8 and 40.7% occurrence, respectively). Chloroform extracts of 21 of 50 *Aspergillus* isolates and 18 of 50 representative *Penicillium* isolates, grown for 4 wk at 21.1°C on artificial medium, were toxic to day-old cockerels. 12 of the toxic *Aspergillus* isolates were identified as *Asp. wentii*, 8 as *Asp. flavus*, and 1 as *Asp. flavus* var.

columnaris. 4 of the toxic *Penicillium* isolates were identified as *P. terrestre*, 3 as *P. steckii*, 2 each as *P. citrinum* and *P. funiculosum*, and 1 each as *P. herquei* (Series) and *P. roqueforti* (Series). Acute diarrhoea was associated with toxicity of *Asp. wentii* and muscular tremors with toxicity of *P. terrestre*, 1 isolate of *P. steckii*, and 1 of *P. funiculosum*. AS

22

[Toxic effect of strains of *Aspergillus flavus* metabolites, isolated from Soviet-grown cereals.]

Meshkov, N. V.; Bogoroditskaya, V. P.

Voprosy Pitaniya No. 4, 59-62 (1975) [1 ref. Ru, en] [Inst. Pitaniya AMN SSR, Moscow, USSR]

Animal tests showed that extracts of pure cultures of 16 *Asp. flavus* strains isolated from cereals grown in the USSR, had a toxic effect in only 1 case (from winter rye). HBr

23

A multiple inoculation technique for the screening of fungal isolates for the evaluation of growth and mycotoxin production on agar substrates.

Barr, J. G.; Downey, G. A.

Journal of the Science of Food and Agriculture 26 (10) 1561-1566 (1975) [11 ref. En] [Queen's Univ., Belfast, UK]

A simple, rapid and quantitative method for evaluation of radial growth and mycotoxin production by a number of toxigenic fungi on an agar substrate is described. A multiple inoculation technique permits rapid inoculation of large numbers of fungal isolates which yield concentric colonies of reproducible diam. after 72 h incubation. No significant variation in the amount of toxin produced by colonies derived from replicate inoculations of the same fungus on different Petri dishes was detected. The reproducibility of toxin production by replicate colonies on agar was satisfactory and the efficiency of toxin extraction was not influenced by the concn. of toxin in agar. AS

24

Patulin: a mycotoxin of potential concern in foods. [Review]

Stott, W. T.; Bullerman, L. B.

Journal of Milk and Food Technology 38 (11) 695-705 (1975) [143 ref. En] [Dep. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, Nebraska 68503, USA]

25

An evaluation of potential mycotoxin-producing molds in corn meal.

Bullerman, L. B.; Baca, J. M.; Stott, W. T.

Cereal Foods World 20 (5) 248-250 (1975) [6 ref. En] [Dep. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, Nebraska 68503, USA]

Incidence of moulds in retail corn meal samples (6 white and 6 yellow brands) varied with brand and ranged from 25 to 59 550 propagules/g. Predominant types of mould found were *Penicillium*, *Aspergillus*, *Fusarium* and *Mucor*. Growth of these moulds on rice powder-corn steep

agar revealed aflatoxins, sterigmatocystin and penicillic acid in culture extracts. *Aspergillus* and *Fusarium* isolates were more toxic than *Penicillium* isolates. No aflatoxins were detected in corn meal from which the *Asp. flavus* strain was isolated, but the organism produced aflatoxin B₁ and B₂ in sterile moistened corn meal, but not in unsterilized meal containing a mixed flora. These observations suggest that there are conditions under which toxins are not produced, particularly when toxic moulds are growing in competition with other microorganisms. VJG

26

Mycotoxin in foodstuffs. V. The influence of temperature, acidity and light on the formation of aflatoxins and patulin in bread.

Reiss, J.

European Journal of Applied Microbiology 1 (2) 183-190 (1975) [17 ref. En] [Mikrobiol. Lab., Grahamhaus Studt KG, D-6550 Bad Kreuznach, Federal Republic of Germany]

The optimal temp. for the growth of *Aspergillus parasiticus* and the formation of aflatoxins B₁ and G₁ on whole wheat bread "Graham" (sliced and packed in cellulose foil) was 25°C. The optimal "total acid content" (Säuregrad) was 5.0. Incubation in light caused no reduction in aflatoxin yields. The optimal temp. for the growth of *Penicillium expansum* on whole wheat bread was 10°C and was between 20° and 25°C for the biosynthesis of patulin. Patulin formation was not influenced by the "total acid content" but was greater under the influence of light than darkness. With increase of incubation time the yields of patulin decreased, probably due to an inactivation by SH-compounds. [See FSTA (1972) 4 3M464 for part III.] AS

27

[Semi-quantitative determination of the mycotoxin patulin by TLC.] Halbquantitative Bestimmung des Mycotoxins Patulin auf Dünnschichtchromatogrammen.

Reiss, J.

Mikrochimica Acta 1 (5/6) 473-475 (1975) [7 ref. De, en] [Mikrobiol. Lab., Grahamhaus Studt KG, D-6550 Bad Kreuznach, Federal Republic of Germany]

Patulin, a mycotoxin contaminant of bread and bakery products, can be determined semi-quantitatively by TLC after spraying the chromatogram with o-dianisidine in glacial acetic acid. The square root of the area of the spot is a linear function of the log of the wt. of patulin. As the area can vary even for the same concn., co-chromatography of ≥ 2 standard concn. with each determination is recommended. RM

28

Systematic analysis of mycotoxins by thin-layer chromatography.

Durackova, Z.; Betina, V.; Nemec, P.

Journal of Chromatography 116 (1) 141-154 (1976) [29 ref. En] [Dep. of Tech. Microbiol. & Biochem., Slovak Polytechnic Univ., Janska 1, 880 37 Bratislava, Czechoslovakia]

Analysis of 37 mycotoxins and other fungal metabolites by TLC is described. Their R_f values in 8 solvent systems, colour reactions after chemical detection and detection under UV light are presented. detection and detection under UV light are presented. Chromatographic spectra were constructed from the R_f values, which, together with data on mp, mol. wt., mass and IR spectra etc., can help in identifying unknown mycotoxins. AL

29

Bioautographic detection of mycotoxins on thin-layer chromatograms.

Durackova, Z.; Betina, V.; Nemec, P.

Journal of Chromatography 116 (1) 155-161 (1976) [6 ref. En] [Dep. of Tech. Microbiol. & Biochem., Slovak Polytechnic Univ., Janska 1, 880 37 Bratislava, Czechoslovakia]

A method for bioautographic detection of mycotoxins on thin layer chromatograms by using *Artemia salina* larvae is described. The method was tested on standard samples of mycotoxins (aflatoxin B₁, kojic acid and sterigmatocystin) and on extracts from toxinogenic fungi isolated from various foodstuffs. The method is simple and reproducible, and could be applied to screening mycotoxins in contaminated foodstuffs and raw materials for foods. AL

30

Effect of a *Fusarium*-toxin on the development of α -amylase activity in germinating barley.

Nummi, M.; Niku-Paavola, M.-L.; Enari, T.-M.

Bios 6 (7/8) 266-269 (1975) [9 ref. En, fr, de] [Biotech. Lab., Tech. Res. Cent. of Finland, Box 192, SF-00121, Helsinki, Finland]

T2 toxin was prepared from a culture of *Fusarium trichinctum* by solvent extraction and partition chromatography on a Kieselgel column. Barley (Pirkka var.) was steeped for 48 h to give a 38-44% moisture content, and groups of 100 grains were germinated on moistened filter paper in Petri dishes. The groups were treated with (i) 0.01 μ g gibberellic acid, (ii) 800 μ g T2 toxin, (iii) 0.01 μ g gibberellic acid + 800 μ g T2, (iv) 80 μ g T2, (v) 8 μ g T2 or (vi) 0.8 μ g T2. α -Amylase activity was measured at intervals during 9 days germination. In group (i) the α -amylase activity increased more rapidly than in the controls up to the 5th day, whereas in (ii) the α -amylase activity was only 40% of that in the controls until the 7th or 8th days when it increased to 55-60% and then fell to 22% on the 9th day. In (iii), the α -amylase activity was less than that in (i) or (ii). With decreasing amounts of T2 present the α -amylase activity on the 9th day of germination increased from 22% in (ii) to 32% in (iv), 47% in (v) and 39% in (vi). The inhibitory effect of T2 appears to depend both on its concn. and on the time of germination. The use of this method for preliminary detection of T2 toxin in foods is discussed. MEG

31

Fate of ochratoxin A in brewing.

Nip, W. K.; Chang, F. C.; Chu, F. S.; Prentice, N. *Applied Microbiology* 30 (6) 1048-1049 (1975) [5 ref. En] [Food Res. Inst., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

The fate of ochratoxin A in brewing was investigated by adding [^3H]ochratoxin A to the raw materials at 1- and 10- $\mu\text{g/g}$ levels during mashing in a conventional microbrewing process. The results indicated that large portions (28-39%) of the added toxin were recovered in spent grains, with less recovery in the yeast (8-20%) and beer (14-18%). About 38 and 12% of the added toxin at levels of 1 and 10 $\mu\text{g/g}$, respectively, were degraded during brewing. AS

32

[Changes in bacterial and mould microflora between harvest and milling.]

Ticha, J.

Mlynsko-Pekarensky Prumysl 21 (8) 248-252 (1975) [12 ref. Cs] [Vyzkumny Ustav Mlynskeho a Pekarenskeho Prumyslu, Prague, Czechoslovakia]

The surface microflora of wheat and rye grains was examined between harvesting and milling. The effect of grain var., cultivation conditions and a growth stimulator on the quantitative and qualitative composition of bacteria, fungi and moulds was considered; results are tabulated. Some of the moulds were capable of producing mycotoxins. STI

33

A note on zearalenone in grain sorghum.

Schroeder, H. W.; Hein, H., Jr.

Cereal Chemistry 52 (5) 751-752 (1975) [5 ref. En] [S. Region, USDA, PO Box ED, College Station, Texas 77840, USA]

Zearalenone, an oestrogenic mycotoxin, was isolated from grain sorghum infected with *Fusarium* spp. A *Fusarium roseum* isolate (S-74-1c) was found to produce most zearalenone when incubated at a constant 25°C. At this temp., more zearalenone was produced on sorghum than on cracked corn (3030 mg/kg vs. 1593 mg/kg after 19 days). PG

34

Influence of carbohydrate and nitrogen source on patulin production by *Penicillium patulum*.

Stott, W. T.; Bullerman, L. B.

Applied Microbiology 30 (5) 850-854 (1975) [25 ref. En] [Dep. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, Nebraska 68583, USA]

A strain of *P. patulum*, isolated from Cheddar cheese, produced patulin when grown on liquid media containing lactose and milk nitrogen sources; 2 incubation temp. were used, 25°C for 2 wk and 5°C for 8.5 wk. Patulin production was affected by the temp. of incubation, type and amount of carbohydrate and type of nitrogen source present; levels generally were depressed by incubation at 5°C and low carbohydrate levels. Patulin was produced at low levels in the absence of sugars at

5°C when the mould was grown on milk nitrogen sources, but was not detected in cultures grown on 25% casein slurries or Cheddar cheese, even though growth of the mould was extensive. AS

35

[Rapid chromatographic method for determination of mycotoxins.]

Burzynska, H.; Maciejaska, K.

Roczniki Panstwowego Zakladu Higieny 26 (6) 671-674 (1975) [4 ref. Pl, ru, en] [Panstwowy Zaklad Higieny, Warsaw, Poland]

The usefulness of chromatography with slides covered with silica gel was assessed in detection and quantitative detn. of aflatoxins B₁, B₂ and G₂, ochratoxin A and sterigmatocystin. This method allows the following amounts of mycotoxins to be demonstrated: aflatoxins B₁, B₂, G₂ 0.0005 μg ; ochratoxin A 0.005 μg ; and sterigmatocystin 0.01 μg . AS

36

[Use of biological methods [chick embryos, *Bacillus megaterium*] for determination of mycotoxins.]

Burzynska, H.; Maciejaska, K.

Roczniki Panstwowego Zakladu Higieny 26 (5) 581-587 (1975) [12 ref. Pl, ru, en] [Panstwowy Zaklad Higieny, Warsaw, Poland]

37

Detection and determination of aflatoxins B₁, B₂, G₁, G₂, M₁, M₂ and parasiticol in cereals and milk.

Janicki, J.; Szabotko, K.; Chelkowski, J.;

Kokorniak, M.; Godlewska, B.; Wiewiorowska, M.

Acta Alimentaria Polonica 1 (3/4) 207-219 (1975) [19 ref. En, pl] [Inst. Tech. Zywnosci Pochodzenia Roslinnego, AR, Poznan, Poland]

Contents of aflatoxins B₁, B₂, G₁, G₂, M₁ and M₂ in samples of commercial dried milk and of 4 cereals (wheat, rye, barley and oats) were investigated. The effectiveness of aflatoxin detection tests was determined on model cereal samples. To confirm the presence of aflatoxins on a single chromatogram the most useful method was to spray the plates with a 25% solution of H₂SO₄ and transform aflatoxins B₁, G₁ and M₁ into their water adducts. No aflatoxins were detected in dried milk samples obtained from dairies in the Poznan province, and aflatoxin B₁ and G₁ were detected in 1 wheat sample of the 35 cereal samples tested. Trials carried out at 4 different temp. (4-6°, 10-12°, 17-20°, and 28-30°C) for 7 days showed that strains of *Aspergillus flavus* and *Asp. parasiticus* were able to synthesize considerably quantities of aflatoxins B₁ and G₁ on autoclaved meals of the 4 cereals even at temp. <10°C. At 28-30°C biosynthesis was much greater at 45% moisture than at 12% moisture content. AL

38

Mycotoxins in foodstuffs. IX. Prevention of the formation of mycotoxins in whole wheat bread by citric acid and lactic acid.

Reiss, J.

Experientia 32 (2) 168-169 (1976) [12 ref. En] [Mikrobiol. Lab., Grahamhaus Studt KG, D-655 Bad Kreuznach, Federal Republic of Germany]

Whole-wheat bread (Grahambrot) was prepared with additions of 0.25, 0.5 and 0.75% of citric or lactic acid. 3-slice samples were packaged in cellulose film and sterilized in hot steam. Total acid content was determined and the packages were inoculated with spores of *Aspergillus parasiticus*, *Asp. versicolor* and *Penicillium expansum*. After incubation for ≤ 10 days at 22°C, bread samples were examined for fungal growth and mycotoxin (aflatoxin, patulin, sterigmatocystin) production. Formation of aflatoxins by *Asp. parasiticus* was suppressed by 0.5% citric acid and by 0.75% lactic acid. Formation of sterigmatocystin by *Asp. versicolor* was suppressed by 0.25% citric acid and by 0.5% lactic acid. Neither citric nor lactic acid had any influence on production of patulin by *P. expansum*. [See FSTA (1976) 8 4M492 for part V.] JA

39

Occurrence of blue-eye condition in commercial popcorn.

Bullerman, L. B.

Cereal Foods World 20 (2) 104-106 (1975) [19 ref. En] [Dep. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, Nebraska 68503, USA]

11 brands each of yellow and white popcorn were surveyed in 1971, 1972, and 1973 for the condition known as 'blue-eye' diseased kernels and other damaged kernels. The extent of the blue-eye condition ranged from 0 to 19.6% of the kernels examined in the various brands. Moulds were isolated from the blue-eye popcorn kernels and found to be mainly *Penicillium* spp. with *P. martensii* Biourge predominating. Screening of the mould isolates for mycotoxin production revealed that 84.4% of the *Penicillium* isolates were capable of producing the mycotoxin penicillic acid, and 39.5% of these were toxic to chicken embryos. No other mycotoxins were detected in the cultures except for ochratoxin A, which was produced simultaneously with penicillic acid by 2 of the isolates. No penicillic acid was detected in blue-eye popcorn kernels. One of 11 samples of popcorn kernels that were surface-sterilized, cracked, and incubated for 10 days at 25°C contained a detectable quantity of penicillic acid. AS

40

Instability of patulin in Cheddar cheese.

Stott, W. T.; Bullerman, L. B.

Journal of Food Science 41 (1) 201-203 (1976) [19 ref. En] [Dep. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, Nebraska 68583, USA]

When 50 µg/g patulin was added to Cheddar cheese and stored at 5° and 25°C for varying time periods, the toxin became undetectable by chemical and biological means. After 3 h $\leq 27\%$ of the added toxin was detected and after 48 h $\leq 16\%$. The reaction was not affected by storage temp. or the presence of microorganisms and thus appeared to be chemical in nature. A patulin producing strain of *Penicillium patulum* grew well on Cheddar cheese at 5° and 25°C, but patulin production was not observed at 5°C, and only small, variable amounts of patulin were noted at 25°C. The patulin formed at 25°C on cheese was authentic as shown by UV absorption maxima and high pressure liquid chromatography, and it possessed biological activity against *Bacillus megaterium* and *Clostridium perfringens*. Potassium sorbate, vacuum packaging and coating cheese with paraffin wax all prevented growth of *P. patulum* on retail size pieces of cheese stored at 5° and 25°C. A heat-sealed wrapping on large (20 lb) blocks of cheese also prevented growth of this organism on cheese stored at 12°C for 6.5 wk. IFT

41

Examination of Swiss cheese for incidence of mycotoxin producing molds.

Bullerman, L. B.

Journal of Food Science 41 (1) 26-28 (1976) [13 ref. En] [Dep. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, Nebraska 68503, USA]

11 brands of Swiss cheese were randomly selected for plate count examination. Mould counts ranged from <10 to 1580 colonies/g of surface cheese at 5°C incubation and <10 -5700 at 21°C. Most of the moulds detected were capable of growing at 5°C in 6 wk. Of the 183 moulds isolated, 87% were *Penicillium* and 13% other genera including 1 isolate of *Aspergillus flavus*. The culture extracts were tested for toxicity to 7-day-old chicken embryos and analysed for the presence of mycotoxins using thin-layer chromatography. 34% of all isolates were toxic, including 35% of penicillia. Mycotoxins (aflatoxins, penicillic acid and patulin) were detected in 5.5% of isolates. LMB

42

Monoacetoxyscirpenol. A new mycotoxin produced by *Fusarium roseum* Gibbosum.

Pathre, S. V.; Mirocha, C. J.; Christensen, C. M.; Behrens, J.

Journal of Agricultural and Food Chemistry 24 (1) 97-103 (1976) [13 ref. En] [Dep. of Plant Path., Univ. of Minnesota, St. Paul, Minnesota 55108, USA]

43

[Mycotoxins in foods. VIII. Inhibition of mould growth and synthesis of mycotoxins (aflatoxins B₁ and G₁, patulin, sterigmatocystin) in wheat wholemeal bread by means of sorbic acid and sorboyl palmitate.] Mycotoxine in Nahrungsmitteln. VIII. Hemmung des Schimmelpilzwachstums und der Bildung Mycotoxinen (Aflatoxine B₁ und G₁, Patulin, Sterigmatocystin) in Weizenvollkornbrot durch Sorbinsäure und Sorboylpalmitat. Reiss, J.

Deutsche Lebensmittel-Rundschau 72 (2) 51-54 (1976) [22 ref. De, en, fr] [Mikrobiol. Lab., Grahamhaus Studt KG, 6550 Bad Kreuznach, Federal Republic of Germany]

Effects of addition of sorbic acid (0.1, 0.3 or 0.5%) or sorboyl palmitate (0.1, 0.3, 0.5 or 0.75%) on the growth of *Aspergillus parasiticus* (an aflatoxin-producing sp.), *Asp. versicolor* (a sterigmatocystin-producing sp.) and *Penicillium expansum* (a patulin-producing sp.) on sliced whole-wheat bread packaged in cellophane film were studied. Control bread samples contained no preservative. Inoculated bread samples were incubated for ≤20 days at 23-25°C. At intervals, mould growth and mycotoxin formation were evaluated; tables and graphs of results are given. It is concluded that addition of 0.1% sorbic acid prevents growth and toxin production by *Asp. versicolor* and *P. expansum*, and considerably inhibits growth and toxin formation by *Asp. parasiticus*. Addition of 0.5% sorboyl palmitate totally inhibits growth and toxin production by *Asp. versicolor*; *Asp. parasiticus* and *P. expansum* can still grow at this concn., but mycotoxin production is inhibited. AJDW

44

Survey of US wheat for ochratoxin and aflatoxin. Shotwell, O. L.; Goulden, M. L.; Hesseltine, C. W. *Journal of the Association of Official Analytical Chemists* 59 (1) 122-124 (1976) [11 ref. En] [N. Regional Res. Lab., USDA, Peoria, Illinois, USA]

A total of 291 hard red winter wheat samples, 286 hard red spring wheat samples, and 271 soft red winter wheat samples were analysed for the presence of ochratoxin and aflatoxin. Samples in all grades came from those collected during crop years 1970-1973 for grade detn. by the Agricultural Marketing Service, USDA. Sensitivity limits of the analytical method as carried out were 1-3 ppb (parts/billion) aflatoxin B₁ and 15-30 ppb ochratoxin A. No aflatoxin was detected in any sample. 3 samples of hard red winter wheat (Grades US No. 4 and 5 and Sample Grade) contained ochratoxin A (trace, 35, and 25 ppb, respectively). 8 of the hard red spring wheats contained ochratoxin A (15-115 ppb); these were in Grades US No. 4 and 5 and Sample Grade. AS

45

A spectrophotometric procedure, using carboxypeptidase A, for the quantitative measurement of ochratoxin A.

Hult, K.; Gatenbeck, S.

Journal of the Association of Official Analytical Chemists 59 (1) 128-129 (1976) [7 ref. En] [Dep. of Pure & Applied Biochem., Royal Inst. of Tech., S-100 44 Stockholm 70, Sweden]

In the method described, ochratoxin A is cleaved into ochratoxin α (free isocoumarin chromophore) and phenylalanine, using carboxypeptidase. Detection is based on the difference in fluorescence excitation spectra of ochratoxin A (380 nm, max.) and ochratoxin α (340 nm, max.). The quantitation of ochratoxin A is based on the loss of fluorescence intensity at 380 nm. The method has been used for the quantitative detn. of as little as 4 µg ochratoxin A/kg barley and barley meal but it could be extended to other products. AS

46

Toxigenic thermophilic fungi.

Wagener, R. E.; Davis, N. D.; Diener, U. L.; Morgan-Jones, G.

Abstracts of the Annual Meeting of the American Society for Microbiology 75, 197 (1975) [En] [Auburn, Univ., Auburn, Alabama, USA]

Stored foods, feeds and grains that become moist and subsequently overheat may provide thermophilic and/or thermotolerant fungi with a competitive advantage over other microorganisms. This study was initiated to screen thermophilic and thermotolerant fungi for toxigenicity. 23 isolates representing 13 spp. of either thermophilic or thermotolerant fungi were bioassayed for toxigenicity to brine shrimp, chick embryos, and rats. 13 isolates representing 9 genera were highly toxic to ≥2 of the 3 systems. Another 7 isolates representing 5 genera were rated slightly toxic. AS

47

Screening method for the detection of aflatoxin, ochratoxin, zearalenone, penicillic acid, and citrinin.

Wilson, D. M.; Tabor, W. H.; Trucksess, M. W. *Journal of the Association of Official Analytical Chemists* 59 (1) 125-127 (1976) [19 ref. En] [Dep. of Plant Path., Univ. of Georgia Exp. Sta., Coastal Plain Sta., Tifton, Georgia 31794, USA]

A modification of the official method for ochratoxins and a screening method for zearalenone, aflatoxin, and ochratoxin is described and expanded to include citrinin and penicillic acid. The method uses 0.5N phosphoric acid-chloroform (1 + 10) in the initial extraction; the extract is divided and eluted from 2 columns to provide a quantitative TLC method for aflatoxin and ochratoxin in corn and dried beans. Aflatoxin and zearalenone are eluted from one column and ochratoxin, penicillic acid, and citrinin from the other. Ochratoxin A recoveries are low (50%) in peanuts. Zearalenone, penicillic acid, and citrinin were qualitatively recovered from corn and beans; zearalenone and penicillic acid were recovered from peanuts but citrinin was not. Several TLC solvents were used to separate interferences. AS

48

Production of rubratoxin by *Penicillium rubrum* in a soy whey-malt extract medium.

Emch, C. O.; Marth, E. H.

Journal of Milk and Food Technology 39 (2) 95-100 (1976) [29 ref. En] [Dep. of Food Sci., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

Sterile soy whey (1.75% dissolved solids) was fortified with malt extract and inoculated with spore suspensions of *P. rubrum* strains P-13, 1062, 2120, 2123 and 3290. Samples were incubated quiescently at 28°C from 1 to 28 days and as shake cultures for 3, 5 and 7 days. Rubratoxin was recovered from culture filtrates by alcohol-acetone extraction and resolved by TLC. Toxin was not produced in shake cultures. Rubratoxins A and B were produced in quiescent soy whey cultures of all *P. rubrum* strains except *P. rubrum* P-13 which produced only rubratoxin B. Toxin production increased as the concn. of malt extract increased from 0.5 to 10% w/v. Rubratoxin formation also increased with an increase in incubation time from 3 to 17 days but the amount of toxin in cultures declined rapidly thereafter. Yields of rubratoxin A ranged from 0.83 to 31.53 mg/100 ml in cultures of *P. rubrum* 1062 and from 1.89 to 22.70, 0.53 to 25.13 and 2.07 to 31.20 mg/100 ml in *P. rubrum* 2120, 2123, and 3290 cultures, respectively. Yields of rubratoxin B ranged from 0.77 to 105.30, 1.03 to 94.83, 2.13 to 91.57, 0.82 to 78.53 and 1.3 to 85.57 mg/100 ml in cultures of *P. rubrum* 13, 1062, 2120, 2123 and 3290, respectively. After max. production, toxin content in cultures levelled off and then decreased. Amounts of toxin declined more rapidly than did mould growth (as measured by mycelial dry wt.). Although malt extract stimulated fungal growth, toxin production was enhanced more than mould growth. AS

49

Effects of ^{60}Co irradiation on ochratoxin production by *Aspergillus ochraceus*.

Applegate, K. L.; Chipley, J. R.

Abstracts of the Annual Meeting of the American Society for Microbiology 74, 11 (1974) [En] [Ohio State Univ., Columbus, Ohio, USA]

Spores of *Asp. ochraceus* NRRL-3574 and NRRL-410 were subjected to irradiation levels of 25-600 krad, at a dose rate of 10.5 krad/min. Spore suspensions were prepared from 14-day-old cultures, irradiated and known concn. then inoculated into a synthetic liquid medium and onto a cracked wheat substrate. 5 replications consisting of daily productions of ochratoxins from the irradiated spore-treated samples were quantitatively determined from day 1 through day 10 via TLC and spectrophotometry. No significant difference was observed in toxin production between the control and spores receiving 25 krad. Irradiation levels of 400 and 600 krad resulted in complete inhibition of spore germination. Notable ochratoxin concn. were observed following exposure of *Asp. ochraceus* to 300 krad when grown on a wheat substrate. Exposures of 150 and 200 krad resulted

in significant toxin production both in wheat and synthetic media over similarly treated non-irradiated controls. Analyses of variance revealed that substrate, time of incubation, as well as irradiation levels, all affected ochratoxin production by this organism. AS

50

Cultural and nutritional factors that control rubratoxin formation.

Emch, C. O.; Marth, E. H.

Journal of Milk and Food Technology 39 (3) 184-190 (1976) [41 ref. En] [Dep. of Food Sci., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

Penicillium rubrum P3290 was grown in a glucose-salts broth with various supplements incubated under different conditions. Max. growth and toxin production were favoured by 20% glucose. Highest yield of rubratoxin A appeared in 6 days and of rubratoxin B in 12 days. Rubratoxin A disappeared from cultures after 22 days, rubratoxin B after 26 days. All amino acids tested supported synthesis of rubratoxin B; highest yields were obtained when the medium contained asparagine or glutamic acid. Yields of toxin were enhanced by 0.2-0.3% ammonium sulphate and mould growth was max. with 5%. Inorganic phosphate generally enhanced toxin production; it was optimal at 0.6% and inhibitory at 9.6%. Zn and Fe were required for toxin production but Mn and Mg were not. A temp. of 25-28°C was optimal; reducing it to 18°C caused a 65% decline in toxin production. When the temp. was increased from 28° to 37° or 45°C, a 60-85% decline in, or complete inhibition of, toxin synthesis occurred. An initial pH of 4-5 enhanced toxin synthesis. RH of 67% allowed rubratoxin formation in 7-day old cultures, RH of 77% supported highest yields of toxin, and 85% allowed accumulation of moderate amounts of rubratoxin. AS

51

[Spectrofluorometric determination of zearalenone (F_2 -toxin) in corn.]Über die spektrofluorometrische Bestimmung des Zearalenone (F_2)-Toxins in Maiskorn.

Sarudi, I., Jr.; Kasa, I.; Bajnoczy, G.

Deutsche Lebensmittel-Rundschau 72 (3) 96-99 (1976) [4 ref. De, en, fr] [Lab. der Staatsgüter im Landesbezirk Fejer, Szekesfehervar-Csala, Hungary]

Comparative studies on detn. of F_2 -toxin in corn by (i) spectrofluorometry (excitation at 320 nm, emission at 455 nm) and (ii) UV spectrophotometry are described. Sample preparation was identical for both methods (extraction of F_2 -toxin with ethyl acetate, and separation by TLC on Kieselgel G using a chloroform/ethanol (95:5) solvent system). Tables and graphs of results are given. (i) gave satisfactory results; (ii) gave a significantly higher scatter and higher error than (i). Results determined by (ii) were 10-15% higher than those determined by (i); this is attributed to inadequate separation of interfering substances during TLC. Through purification of the extract before analysis improved results with (ii). AJDW

52

Survey for aflatoxins and zearalenone in 1973 crop corn stored on farms and in country elevators.

Stoloff, L.; Henry, S.; Francis, O. J., Jr.

Journal of the Association of Official Analytical Chemists 59 (1) 118-121 (1976) [12 ref. En] [Div. of Food Tech., FDA, Washington, DC 20204, USA]

A total of 315 marketable and 57 obviously damaged corn samples were collected at 116 different farms and country elevators located in the USA in counties selected from among those producing >1 million bushels of corn in 1972. The samples were analysed for aflatoxins and zearalenone. The most striking correlations observed were between geographical area and mycotoxin contamination. Aflatoxin contamination was most frequently encountered in the Southeast-Appalachia areas with a 44% incidence of marketable corn with detectable aflatoxins. Zearalenone was most frequently encountered in the Corn Belt with a 10% incidence in marketable corn from that region. When mycotoxin contamination was found in an establishment, most of the samples from that establishment were contaminated. There was no correlation between mycotoxin contamination and storage practices nor could the observed contamination of marketable corn be related to the contamination of the obviously damaged grain. These observations plus correlations with the geographic incidence and aflatoxin level distribution of published field contamination data suggest the possibility of a common contamination mode. AS

53

Simple method for simultaneous detection of aflatoxin and zearalenone in corn.

Seitz, L. M.; Mohr, H. E.

Journal of the Association of Official Analytical Chemists 59 (1) 106-109 (1976) [11 ref. En] [US Grain Marketing Res. Cent., USDA, 1515 College Avenue, Manhattan, Kansas 66502, USA]

A method is described of the simultaneous detection of aflatoxin and zearalenone in corn at 5 and 200 ppb (parts/billion) respectively. No evaporation of solvent is required and the procedure is simple enough to be considered for use at marketing locations. The presence or absence of these mycotoxins can be determined in 10-20 min/sample. The procedure involves and initial blender extraction with methanol, partitioning of fat and pigments into 1,1,2-trichlorotrifluoroethane (Freon-113) from an aqueous ammonium sulphate layer, followed by extraction of aflatoxin from the aqueous layer with chlorobenzene. The chlorobenzene extract can be spotted directly onto a TLC plate which requires only 4 min development. Conc. of aflatoxin and zearalenone can be estimated by visual comparison of sample spots with standards. AS

54

Chemical preservatives for prevention of mycotoxin production.

Anon.

Nutrition Reviews 34 (1) 31 (1976) [6 ref. En]

This very brief review concludes that propionic acid should find application in the prevention of mycotoxin formation in stored corn; treatment with NH_3 was effective for only a week. [See also FSTA (1975) 7 7M835.] AL

55

[PR-toxin production by *Penicillium roqueforti* strains.] PR-Toxinbildung bei *Penicillium roqueforti*-Stämmen.

Orth, R.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 160 (2) 131-136 (1976) [14 ref. De, en] [Inst. für Physik & Biol., Bundesforschungsanstalt für Ernährung, Karlsruhe, Federal Republic of Germany]

A commercial blue-cheese starter, 3 *P. roqueforti* isolates from commercial cheeses, and isolates from canned pate sausage, 2 red-wine-bottle corks, nut ice cream, 2 Roquefort cultures, dessert cream (not otherwise specified) and bread were examined for PR-toxin by the method of Wei et al. [Applied Microbiology (1973) 25, 111; Tetrahedron (1975) 31, 109]. The starter, cheese isolates and Roquefort cultures produced no toxin in growth at 15° or 30°C. The pate sausage and bread isolates were also negative at both temp., but the nut ice cream isolate, red-wine-bottle cork isolate and the dessert cream isolate produced the toxin at 15°C at respectively 0.31, 0.935 and 0.96 ppm; and the cream produced it also at 0.031 ppm at 30°C. Isolates other than those from the starter, commercial cheeses and bread were also tested by the chick embryo test, and all were found to produce the toxin at 0.004-0.012 ppm. SKK

56

Effects of volatile bacterial metabolites on the growth, sporulation and mycotoxin production of fungi.

Barr, J. G.

Journal of the Science of Food and Agriculture 27 (4) 324-330 (1976) [17 ref. En] [Queen's Univ., Belfast, UK]

5 toxigenic fungi [4 *Penicillium* spp., 1 *Aspergillus* sp.] were grown in the presence of pure cultures of a number of different bacteria. Alternations in the gaseous environment resulting from bacterial growth produced changes in the growth, sporulation and toxin production of the fungi. Different fungi varied in their response to any one bacterium, and different bacteria produced a variety of responses from each individual fungus. The growth, sporulation and toxin production of most fungi were normally inhibited by the presence of bacteria; in a few cases toxin production was stimulated. Toxin production was able to proceed in the absence of sporulation. The implications of bacterium-fungus interactions in certain environments are considered. AS

57

[Growth of and toxin production by sterigmatocystin- and patulin-producing moulds under controlled atmospheres.] Wachstum und Toxinbildung von Patulin- und Sterigmatocystin-bildenden Schimmelpilzen unter kontrollierter Atmosphäre.

Orth, R.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 160 (4) 359-366 (1976) [19 ref. De, en] [Inst. für Physik und Biol., Bundesforschungsanstalt für Ernährung, Engesserstr. 20, D-7500 Karlsruhe, Federal Republic of Germany]

The influence of controlled atmospheres on growth of and toxin production by *Aspergillus versicolor*, *Penicillium expansum*, *P. urticae* and *Byssoschlamys nivea* was studied. Low O₂ atmospheres (2-0.5%) had scarcely any influence on growth and toxin production in different nutrient media after 14 days at 25°C. Only CO₂ concn. higher and O₂ concn. lower than those in air (e.g. 40% CO₂, 6% O₂) reduced sterigmatocystin and patulin production; growth was insignificantly retarded. Atmospheres of 90% CO₂ and 10% air as well N₂ atmospheres with 10% CO₂ inhibited growth and prevented toxin production by nearly all strains. In pure N₂ atmospheres most *Asp. versicolor* strains exhibited growth and toxin production whereas only min. growth of patulin-producing species and no patulin synthesis were observed. AS

58

[Studies on mycotoxins in foods. III. Analytical procedure for fusarenone-X in rice, barley and powdered wheat.]

Naoui, Y.; Saito, K.; Kazama, E.; Ogawa, H.; Kimura, Y.

Annual Report of Tokyo Metropolitan Research Laboratory of Public Health 23, 175-182 (1971, publ. 1972) [27 ref. Ja, en] [Dep. of Food Hygiene and Nutr., Tokyo Metropolitan Res. Lab. of Public Health, Tokyo, Japan]

The method involves extraction, clean-up and TLC on a plate illuminated by UV light, sprayed with 50% AlCl₃ solution and heated. [From En summ.] JA

59

[Studies on mycotoxins in foods. IV. Determination of sterigmatocystin in miso and soy sauce.]

Naoui, Y.; Ogawa, H.; Kazama, E.; Saito, K.; Shimura, K.; Kimura, Y.

Annual Report of Tokyo Metropolitan Research Laboratory of Public Health 24, 207-217 (1972, publ. 1973) [10 ref. Ja, en] [Div. of Food Hygiene, Dep. of Food Hygiene & Nutr., Tokyo Metropolitan Res. Lab. of Public Health, Tokyo, Japan]

The authors developed a method for detecting sterigmatocystin in miso and soy sauce. As many fluorescent materials are extracted from miso and soy sauce with methanol and chloroform, clean-up is essential. Florisil and Kiesel Gel or Florisil and

Celite are suitable as carriers for TLC.

Sterigmatocystin is recognized as yellow spots under UV light, after spraying a 20% aluminium chloride-ethanol solution on the TLC plate and heating at 80°C for 10 min. It is quantitatively determined with a fluorescent densitometer.

Recovery is 90-96%. AS

60

[Studies on mycotoxins in foods. V. Analytical procedure for T-2 toxin and diacetoxyscirpenol in milled wheat.]

Naoui, Y.; Kazama, E.; Saito, K.; Ogawa, H.; Shimura, K.; Kimura, Y.

Annual Report of Tokyo Metropolitan Research Laboratory of Public Health 25, 203-206 (1974, publ. 1975) [3 ref. Ja, en] [Tokyo Metropolitan Res. Lab. of Public Health, 24-1, Hyakunincho 3 chome, Shinjuku-ku, Tokyo 160, Japan]

A procedure for detection of trichothecene-type mycotoxins (T-2 toxin and diacetoxyscirpenol) and its application to milled wheat are described. The toxins are visualized under visible or UV light (360 nm) after spraying the TLC plate with 20% H₂SO₄ and then heating at 105°C for 20 min. AS

61

[Ochratoxin A in coffee.] Ochratoxin A im Kaffee. Gallaz, L.; Stalder, R.

Chemie Mikrobiologie Technologie der Lebensmittel 4 (5) 147-149 (1976) [9 ref. De, en, fr] [Societe d'Assistance Tech. pour Produits Nestle SA, Lab. Biol., Orbe, Switzerland]

Aspergillus ochraceus, a natural contaminant of green coffee, produced 40 parts/billion of ochratoxin A when grown on coffee under laboratory conditions. During roasting, 80-90% of the ochratoxin was destroyed. AS

62

Penicillic acid production in cherries by *Aspergillus* and *Penicillium* species.

Lovett, J.; Boutin, B.; Thompson, R. G.

Abstracts of the Annual Meeting of the American Society for Microbiology 74, 10 (1974) [En] [FDA, Cincinnati, Ohio 45226, USA]

The purpose of this experiment was to determine the potential for mycotoxin contamination in mould-damaged cherries. 8 penicillic acid-producing strains of *Aspergillus* and *Penicillium* sp. were grown on canned tart cherries packed in water (no added carbohydrate). Cultures were assayed for penicillic acid on days, 6, 8, 10, and 12. The cultures were extracted twice with equal vol. of ethyl acetate. The ethyl acetate extract was washed twice with 3% sodium bicarbonate and the ethyl acetate fraction discarded. The sodium bicarbonate fraction was titrated to pH 3.0 with HCl and extracted twice with ethyl acetate. The last ethyl acetate extract containing the penicillic acid was reduced to 5 ml and spotted on Absorbisil-5 TLC plates. The plates were developed in benzene:methanol:acetic acid (90:7:3) and air

dried. After spraying with 0.5% 3-methyl-2-benzothiazolinone hydrazone hydrochloride monohydrate, the plates were heated for 15 min at 135°C for colour development. Mycotoxin was produced by *Asp. melleus* NRRL 386 and NRRL 3520, *Asp. sclerotiorum* NRRL 4901 and NRRL 3793, and *P. puberulum* NRRL 1889 and NRRL 3564. AS

63

Amatoxins in edible mushrooms.

Faulstich, H.; Cochet-Meilhac, M.

FEBS Letters 64 (1) 73-75 (1976) [9 ref. En] [Max-Planck-Inst. für Med. Forschung, Abteilung Naturstoff-Chem., Jahnstrasse 29, D-69

Heidelberg, Federal Republic of Germany]

Samples of edible mushrooms (*Amanita rubescens*, *Agaricus silvaticus*, *Boletus edulis*, *Cantharellus cibarius*) and inedible *Amanita* spp. were analysed for amatoxins by radioimmunoassay and by inhibition of RNA-polymerase B. A table of results is given. The results show that all mushroom spp. studied contain amatoxins, concn. in edible spp. are, however, very low (≤ 9.1 ng/g fresh tissue). AJDW

64

Bulk shipments of washed and unwashed potatoes to chip processors - comparison of usable weight and cost.

Bowman, E. K.; Hensel, D. R.

Proceedings of the Florida State Horticultural Society 87, 265-272 (1974) [2 ref. En] [Agric. Res. Service, USDA, Gainesville, Florida, USA]

The usable wt. and cost of washed or unwashed potatoes to chip processors was compared. Samples from 4 bulk-loading points showed that approx. 4.2% of wt. was lost from initial sample of unwashed potatoes on arrival at the processing plant, vs. 9.3% from washed potatoes by removal of culls and dirt. Subsequent loss after 6 wk storage at the processing plant and removal of decayed and spongy potatoes was 6.03% for unwashed, 6.74% for washed potatoes, or 6.29 and 7.44% based on the wt. of samples when placed in the holding room. Except for the rate of wt. loss, the behaviour of washed potatoes during holding was as satisfactory as that of unwashed potatoes: amounts of unusable (decayed and spongy) potatoes at the end of 6 wk was 3.07% and 2.39% of initial sample wt. respectively, with the % difference not statistically significant at the 5% level. The results are discussed in terms of raw material costs to the processor. RM

65

Vomitoxin isolation from *Fusarium*-infected corn.

Vesonder, R. F.; Ciegler, A.; Jensen, A. H.

Abstracts of the Annual Meeting of the American Society for Microbiology 74, 10 (1974) [En] [N. Regional Res. Lab., USDA, Peoria, Illinois, USA]

Cereal grains contaminated with fusaria have been known to cause vomiting and illness if consumed by humans and some domesticated animals. *Fusarium*-infected corn is often rejected by swine. The emetic principal was isolated from

contaminated corn and shown to be a trichothecene, 3,7,15-trihydroxy-12,13-epoxy-trichothene-9-en-8-one. The trivial name, vomitoxin, was assigned to this compound. Preliminary data indicate that this same substance may also be the 'rejection factor'. Attempts to detoxify contaminated corn by heating, ammoniation, or ensiling have been unsuccessful. AS

66

Production of ochratoxin A by *Aspergillus ochraceus* NRRL-3174 before and after exposures to ^{60}Co irradiation.

Applegate, K. L.; Chipley, J. R.

Applied and Environmental Microbiology 31 (3) 349-353 (1976) [24 ref. En] [Dep. of Food Sci. & Nutr., Ohio State Univ., Columbus, Ohio 43210, USA]

Spores from *Asp. ochraceus* NRRL-3174 were exposed to specific levels of γ -irradiation and allowed to germinate on selected media. Increases in ochratoxin A production by irradiated, compared to non-irradiated, spores were observed after inoculation of spores onto a cracked red wheat or into a synthetic liquid medium. Variations in daily ochratoxin production were also observed for control and irradiated spore-derived cultures developing on both media, with max. toxin production varying from 7 to 11 days of incubation. The most notable increases in ochratoxin A production occurred from cultures developing from spores irradiated with 10, 25, or 50 krad. Exposures to 400 or 600 krad resulted in complete inhibition of spore germination and, consequently, no ochratoxin production. Of the 2 substrates, wheat and synthetic, quantities of ochratoxin A produced were significantly lower in the synthetic medium. Higher and more rapid toxin production occurred from spores irradiated with 10, 25, 50 and 100 krad than from non-irradiated control spores when grown on synthetic medium. Cultures derived from spores exposed to 10, 25, and 50 krad produced significantly higher levels of ochratoxin A after 8 days of incubation on natural substrate than did the controls. Analysis of variance revealed that substrate, length of incubation, as well as irradiation levels all affected the time required to produce max. levels of ochratoxin A. AS

67

Mycotoxins in foodstuffs. VII. Inactivation of patulin in whole wheat bread by sulphhydryl compounds.

Reiss, J.

Cereal Chemistry 53 (2) 150-152 (1976) [16 ref. En] [Mikrobiol. Lab., Grahamhaus Studt KG, 655 Bad Kreuznach, Federal Republic of Germany]

Patulin is inactivated by an aqueous extract of whole wheat bread at pH 5. The detoxification of patulin by glutathione and cysteine suggests that sulphhydryl compounds are responsible for the failure to detect this toxin in bread after prolonged incubation. [See FSTA (1976) 8 4M492 for part V.] AS

68

[Studies of fungal contamination of foodstuffs in Japan: fungal flora and incidence of toxin-producing fungi in minced meat marketed in Tokyo.]

Hitokoto, H.; Morozumi, S.; Wauke, T.; Zen-Yoji, H.

Annual Report of Tokyo Metropolitan Research Laboratory of Public Health 24, 41-46 (1972, publ. 1973) [19 ref. Ja, en] [Div. of Bact. I, Dep. of Microbiol., Tokyo Metropolitan Res. Lab. of Public Health, Tokyo, Japan]

165 samples of minced meat collected from retailers in Tokyo were examined for fungal contamination. The 66 776 isolates obtained were classified into about 25 genera. The predominant genera were *Aureobasidium*, *Phoma*, *Fusarium* and *Cladosporium*, each one constituting about 10% of the total isolates. Strains of *Aspergillus flavus* isolated were capable of producing aflatoxins B₁ and B₂, but not aflatoxin G, when cultured in SL medium. Strains of *Asp. versicolor* isolated were found to have sterigmatocystin-producing ability in YES medium. AS

69

[Chlor-tolidine and chlor-dianisidine as thin layer chromatographic detection reagents for patulin.]

Chlor-Tolidin und Chlor-Dianisidin als dünnschichtchromatographische Detektionsreagenzien für Patulin.

Meyer, R. A.

Nahrung 20 (1) 79-80 (1976) [10 ref. De] [Bezirkshygieneinspektion Dresden, Inspektion Ernährungshygiene, German Democratic Republic]

A method for detection of the mycotoxin patulin is described, based on separation by TLC on kieselgel G, using a chloroform/acetone/85% formic acid (66:31:3) solvent system. Before spraying, the plate is placed in a Cl₂ chamber for 3 min. It is then sprayed with o-tolidine reagent, and heated for 15-20 min. at 80°C. Alternatively, after removal from the Cl₂ chamber, the plates may be sprayed with o-dianisidine reagent. With both reagents, patulin spots give a yellow/green fluorescence in UV light, and are yellow in daylight. Detection limits are 5 ng (in UV light) and 10 ng (in daylight). R_f values for patulin ochratoxin A and aflatoxins B, and G, are given. IN

70

Development of aflatoxin in 'Stuart' pecans as affected by shell integrity.

Schroeder, H. W.; Storey, J. B.

HortScience 11 (1) 53-54 (1976) [4 ref. En] [Agric. Res. Service, USDA, College Station, Texas 77840, USA]

The intact shell of pecans *Carya illinoensis* (Wang.) K. Koch cultivar Stuart provided a protective barrier to invasion of the kernels by *Aspergillus flavus* and to the development of kernel discoloration. After 28 days exposure to high humidity on *A. flavus* infested soil 36% of the

surface area of pecan kernels from sound inshell nuts was discolored compared to 100% of the surface area of kernels from pecans with cracked shells. Aflatoxins were detected after 8 days in kernels (not obviously discolored or mouldy) from cracker inshell nuts at a concn. of 3500 parts/billion and reached a max. concn. of 1 000 000 parts/billion after 21 days. Aflatoxins (840 parts/billion) were detected in pecans with sound shells after only one of 5 exposure periods (21 days) suggesting that one nut may have had a defective shell or may have been previously contaminated. The mycotoxin, zearalenone, was extracted from kernels with sound shells after 28 days. AS

71

[Identification and semiquantitative determination of ochratoxins A and B, sterigmatocystin and aflatoxin B₁.]

Lemieszek-Chodorowska, K.

Roczniki Panstwowego Zakladu Higieny 27 (2) 153-160 (1976) [20 ref. Pl, ru, en] [Panstwowy Zaklad Higieny, Warsaw, Poland]

One-dimensional TLC was used for identification and semiquantitative detn. of the title mycotoxins, isolated from cereals (wheat, rye, rice). The extracts were purified using chromatographic columns filled with Celite (ochratoxins) or silical gel (aflatoxin B₁ and sterigmatocystin). The purified extracts were developed on the same chromatogram with a single solvent system, benzene:methanol:acetic acid (90:5:5). Fluorescence of the mycotoxins was evaluated at a wavelength of 366 nm; sterigmatocystin was visualized by spraying with an ethanolic solution of AlCl₃, and an ethanol-water solution of NaHCO₃ was used to increase the fluorescence of the ochratoxins. The R_f values obtained were: aflatoxin B₁, 0.25-0.28; ochratoxin B, 0.30-0.33; ochratoxin A, 0.40-0.43; sterigmatocystin, 0.56-0.59. The lowest amounts determined on chromatograms were (µg): aflatoxin B₁, 0.001; ochratoxins A and B, 0.0025; sterigmatocystin, 0.005. AS

72

Zearalenone: distribution in dry-milled fractions of contaminated corn.

Bennett, G. A.; Peplinski, A. J.; Brekke, O. L.; Jackson, L. K.; Wichser, W. R.

Cereal Chemistry 53 (3) 299-307 (1976) [19 ref. En] [N. Regional Res. Lab., USDA, Peoria, Illinois 61604, USA]

3 lots of naturally contaminated yellow corn from the 1972 crop were dry milled to determine the distribution of zearalenone in mill fractions. 2 different procedures were used to mill representative samples of the 3 lots of contaminated corn. Zearalenone and fat contents of each fraction were determined, and their distributions calculated. Dry cleaning of the corn before milling removed 3-10% of the zearalenone. All mill fractions from both procedures were contaminated with zearalenone. The highest levels

of contamination were in the hull and high-fat fractions. Prime product mix (grits, low-fat meal, and flour, representing product yields of 57-63%) contained approx. 20% of the zearalenone of the whole corn. AS

73

[The significance of mycotoxins in the food industry.]

Szigeti, G.

Élelmezési Ipar 29 (3) 87-89 (1975) [Hu, en, de, ru] [Allategeszegügyi Intezet Miskolc, Doczyu 6, Hungary]

The main mycotoxins of significance in food products are discussed, with reference to species forming these toxins, foods in which they are found, conditions for their formation, toxic effects, and LD₅₀ values. AJDW

74

Hydrogenation used in the detection of zearalenone (F₂ toxin). Preliminary communication.

Sarudi, I., Jr.

Acta Alimentaria 5 (1) 37-40 (1976) [3 ref. En] [Special Sta., Nat. Estates of County Fejer, H-8000 Szekesfehervar-Csala, Hungary]

The 4-methoxy-benzene-diazonium-fluoroborate method [FSTA (1974) 6 5M642] may be used in detecting F₂ toxin after separation by TLC. The method can also be applied after hydrogenation of the oxo-group of the toxin with sodium-borohydride in a methanol-containing medium. However, a substantial difference is observed between the R_F-values of the original toxin and of its transformed variant: 0.55 vs. 0.4. AS

75

[The influence of water activity on the spore germination of aflatoxin-, sterigmatocystin- and patulin-producing moulds.] Der Einfluss der Wasseraktivität auf die Sporenkeimung bei Aflatoxin, Sterigmatocystin und Patulin bildenden Schimmelpilzarten.

Orth, R.

Lebensmittel-Wissenschaft und -Technologie 9 (3) 156-159 (1976) [22 ref. De, en] [Bundesforschungsanstalt für Ernährung, Engesserstrasse 20, D-75 Karlsruhe 1, Federal Republic of Germany]

The limiting water activity (a_w) for germination of conidiospores of different mycotoxin-producing moulds was determined on a Czapek-Dox medium at 25°C. The strains tested were: *Aspergillus flavus*, *Asp. parasiticus*, *Asp. versicolor*, *Asp. nidulans*, *Penicillium urticae*, *P. expansum* and *Byssoschlamys nivea*. The a_w limit was found to be the same (0.84) for all strains. Spore germination was examined by microscopy during incubation for 10 days. The Czapek-Dox medium had at 0.84 a_w, according to the adsorption isotherm, a water content of 74% (w/w). No mould growth was observed at a lower a_w value even after incubation for 3 wk. AS

76

Effects of subatmospheric pressures on the growth and patulin production of *Penicillium expansum* and *Penicillium patulum*.

Adams, K. B.; Wu, M. T.; Salunkhe, D. K.

Lebensmittel-Wissenschaft und -Technologie 9 (3) 153-155 (1976) [18 ref. En] [Dep. of Nutr. & Food Sci., Utah State Univ., Logan, Utah 84322, USA]

Effects of subatmospheric pressures [160-646 mm Hg] on patulin production and mycelial growth by *P. expansum* and *P. patulum* at 15°C were investigated. Patulin production by *P. expansum* was significantly increased over that of a control when incubated at 320 mm Hg but decreased at 160 mm Hg. Mycelial growth of *P. expansum* was inhibited only when incubated at 160 mm Hg. Patulin production and mycelial growth of *P. patulum* at 480 and 320 mm Hg were not significantly different from those of a control. Incubation at 160 mm Hg significantly inhibited both patulin production and growth of *P. patulum*. AS

77

Mycotoxins; toxicity, carcinogenicity, and the influence of various nutritional conditions. [Review]

Newberne, P. M.

Environmental Health Perspectives No. 9, 1-32 (1974) [165 ref. En] [Dep. of Nutr. & Food Sci., Massachusetts Inst. of Tech., Cambridge, Massachusetts 02193, USA]

This review covers the literature on mycotoxicoses but centres on those about which most is known, particularly diseases associated with metabolites elaborated by some strains of *Aspergillus*, *Penicillium*, *Fusarium*, *Stachybotrys* and *Claviceps*. Aflatoxins (toxic metabolites of *Asp. flavus*) are ubiquitous and their ingestion is associated with endemic liver disease. Ergotism, caused by toxins of *C. purpurea*, is considered in detail. Alimentary toxic aleukia, a disease largely of Russian populations, has been linked with toxic products of *Fusarium* spp. *Stachybotryotoxicosis* and diseases associated with toxins of *Penicillium* spp., including acute and chronic hepatotoxicity, are discussed, and factors which influence susceptibility to mycotoxins and the hazards they present to man are also reviewed. AS

78

Rubratxin formation in soybean substrates.

Emeh, C. O.; Marth, E. H.

Journal of Milk and Food Technology 39 (4) 253-257 (1976) [31 ref. En] [Dep. of Food Sci., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

Sterile soybeans, low and full fat soy meal, soy residue, soy curd, and soy whey fortified with different nutritional supplements were inoculated with spore suspensions of *Penicillium rubrum* P-

3290. Yeast extract-sucrose (YES), glucose-malt extract, maltose-soytone, soy whey containing 1.75, 3.5 and 5.5% dissolved solids, and a maltose-salts medium were also inoculated. Cultures were incubated quiescently at 28°C for 7, 10 or 14 days. Rubratoxins (Ru) were extracted with ethyl acetate and diethyl ether and resolved by TLC. Greatest yields of Ru were obtained from natural rather than chemically defined media. Semi-synthetic media supported formation of moderate amounts of Ru. Malt extract and glucose supported greatest production of both Ru A and B. Unsupplemented soy whey or soy milk did not support Ru production. Although soy meal supported production of Ru A and B (0.12-0.24 mg/g and 0.55-0.71 mg/g), low fat soy meal was more suitable for Ru formation than was full fat meal. Ru A and B were produced by *P. rubrum* grown in soy whey fortified with soytone, malt extract, or glucose; only Ru B was produced when yeast extract or sucrose served as supplements. YES broth supported formation of only Ru B. Production of Ru in soybeans was influenced by time of incubation and temp. Max. yields of Ru on soybeans were obtained after 14 days of incubation at 25°C, after 28 days at 28°C, after 7 days at 32°C and after 3 days at 37°C. Ru was not produced at 40°C. AS

79

[Occurrence of moulds in rye flour.]

Nilsson, G.; Ikeakor, T.

Var Föda 26 (4) 76-79 (1974) [2 ref. Sv, en]
[Statens Livsmedelsverk, S-104 01 Stockholm, Sweden]

Samples of rye flour from 9 shops (supplied by 3 different mills) were tested for the presence of moulds. A table is given showing counts of total moulds, fluorescing *Aspergillus* spp., and fluorescing *Penicillium* spp., and the proportion of samples containing *Mucor* or *Alternaria* spp. Mean total mould counts ranged from 445 to 4500/g; one mill consistently produced samples with lower mould counts than the other two. Fluorescing aspergilli and penicillia comprised respectively 0-5.6% and 0.3-21% of the total mould count. Most samples contained *Mucor* spp.; few contained *Alternaria* spp. No aflatoxin-forming or zearalenone-forming strains were detected; 10 *Aspergillus* strains and 1 *Penicillium* strain were capable of producing low concn. of ochratoxin. AJDW

80

Mycotoxins in foodstuffs. VI. Formation of sterigmatocystin in bread by *Aspergillus versicolor*.
Reiss, J.

Zeitschrift für Lebensmittel-Untersuchung und -Forschung 160 (3) 313-319 (1976) [44 ref. En, de] [Mikrobiol. Lab., Grahamhaus Stadt KG, D-6550 Bad Kreuznach, Federal Republic of Germany]

Various sliced loaves (whole wheat bread, whole rye bread with shredded wheat, whole rye bread,

whole wheat bread with wheat germs, whole wheat bread with linseed), ranging in acidity (Säuregrad) from 4.0 to 9.8, were packaged in cellulose, inoculated with spores of one of 2 strains of *Asp. versicolor* and incubated at 4-35°C. Fungal growth and sterigmatocystin production were determined at 24 h intervals. Both strains grew well on whole wheat bread, bread with linseed and bread with wheat germs but not on bread with shredded wheat or whole rye bread. When the acidity of the 2 latter breads was decreased from 9.8 to 4.0-5.7, growth improved. Optimal temp. for growth was 20-30°C and for toxin production 20°C. Sterigmatocystin was produced on all breads except whole rye bread. Max. yields (0.1-0.4 µg/g) were produced on bread with shredded wheat and bread with wheat germs. [See FSTA (1976) 8 4M492 for part V.] JA

81

Determination of zearalenone in corn: collaborative study.

Shotwell, O. L.; Goulden, M. L.; Bennett, G. A.

Journal of the Association of Official Analytical Chemists 59 (3) 666-670 (1976) [6 ref. En] [N. Regional Res. Lab., USDA, Peoria, Illinois 61604, USA]

Corn samples spiked at levels of 100, 300, 1000, and 2000 µg zearalenone/kg were sent to 22 collaborators for analysis by the Eppley method. All samples were yellow corn except 1 white corn sample spiked at 2000 µg/kg. Results from 16 collaborators were statistically analysed. Only 4 of 16 collaborators detected zearalenone in the sample containing 100 µg/kg, but 11 detected the toxin in the sample containing 300 µg/kg. Average recoveries from all samples were 129% at 300 µg/kg, 101% at 1000 µg/kg, and 88% at 2000 µg/kg. The between-laboratory coeff. of variation were 53.0% at 300 µg/kg, 38.2% at 1000 µg/kg, and 27.0% at 200 µg/kg. 5 naturally contaminated corn samples, 1 in triplicate, were also provided. The mean level of zearalenone in the naturally contaminated samples ranged from 431 to 7622 µg/kg. The mean coeff. of variation for all samples was 40.5%. 2 collaborators measured quantities of zearalenone on TLC plates densitometrically. Their results were not included in the statistical analysis, but the results indicated that densitometric measurement, given proper dilutions of solutions, could be used. The method has been adopted as official first action. AS

82

[Mycotoxin production by fungi isolated from wheat and barley grains.]

Ichinoe, M.; Takatori, K.; Tanaka, S.; Kumata, H.; Suzuki, T.; Kurata, H.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 16 (6) 381-390 (1975) [36 ref. Ja, en] [Nat. Inst. of Hygienic Sci., Kamiyoga, Setagaya, Tokyo, Japan]

Aspergillus, *Penicillium* and *Alternaria* were found in 70-80% of samples of wheat and barley

grain; *Cladosporium*, *Rhizopus* and *Mucor* were also commonly isolated. Aflatoxin, sterigmatocystin, ochratoxin, penicillic acid and patulin were produced by some strains. TM

83

Analysis of T-2 toxin (and HT-2 toxin) by mass fragmentography.

Pareles, S. R.; Collins, G. J.; Rosen, J. D.

Journal of Agricultural and Food Chemistry **24** (4) 872-875 (1976) [16 ref. En] [Dep. of Food Sci., Cook Coll., Rutgers Univ., New Brunswick, New Jersey 08903, USA]

A method for the rapid screening of T-2 toxin (3-hydroxy-4,15-diacetoxy-8-(3-methylbutyryloxy)-12,13-epoxy- Δ^9 -trichothecene) in milk is presented. At the 1.25-ppm level, recovery is about 70%. The lower limit of detectability is estimated at 300 parts/billion. Although more research involving the use of deuterated T-2 toxin as a internal standard is needed before the method can be used as a routine quantitative procedure, an acceptable alternative to the rabbit-skin assay confirmation procedure is provided for use with both milk and corn. Furthermore, the proposed method can be used for the simultaneous semiquantitation and confirmation of both T-2 and HT-2 toxins. AS

84

Effects of prenatal administration of citrinin and viriditoxin to mice.

Hood, R. D.; Hayes, A. W.; Scammell, J. G.

Food and Cosmetics Toxicology **14** (3) 175-178 (1976) [20 ref. En] [Dep. of Biol., Univ. of Alabama, Alabama 35486, USA]

This report considers the toxic fungal metabolites citrinin (elaborated by *Aspergillus* and *Penicillium* spp.) and viriditoxin (produced by *Aspergillus* viridinutans). It is one of a series dealing with the effects of mycotoxins on developing mammals. 0 (control), 10, 20, 30 or 40 mg/kg of citrinin and 0, 2, 3 or 3.5 mg/kg of viriditoxin were administered intra-peritoneally to mice on one of days 7-10 of pregnancy. No significant increase in foetal abnormalities was associated with exposure to either toxin, and viriditoxin had little effect on prenatal survival or growth. The highest doses of citrinin were sometimes fatal to the dams and those of viriditoxin were often fatal. VJG

85

[Microbiological aspects of food preservation.]

Mikrobiologische Aspekte der Haltbarmachung von Lebensmitteln.

Brandl, E.

L und E **28** (11) 267-270 (1975) [De, en] [Inst. für Milchhygiene & Milchtech., Tierärztliche Hochschule, Vienna, Austria]

The following items are discussed in an abridged version of a lecture: action of heat treatment on

microorganisms in milk; preservation by technological alteration of foods; the positive role of microorganisms in the production of fermented foods; and foods as carriers of pathogenic microorganisms and toxinogenic moulds. AS

86

[Changes in the bacterial and mould microflora of grain between harvesting and milling. II. Microflora in stored grain; its effect on grain quality.]

Ticha, J.

Mlynsko-Pekarensky Prumysl **21** (12) 377-381

(1975) [Cs] [Vyzkumny Ustav Mlynskeho a Pekarenskeho Prumyslu, Prague, Czechoslovakia]

A study was made of moulds in stored grain and their effect on grain quality. The growth of moulds in stored grain results in pronounced sensory and biochemical changes. Sensory changes include production of a stale smell, which is also evident in flour produced from the grain, and deterioration of taste and colour. Biochemical changes include a rapid loss of glycolipids, and decreased vol. and porosity in products baked from the grain. Mould growth, particularly of *cladosporia* and *fusaria*, can present a health hazard due to mycotoxin production. Mould growth can be inhibited by avoiding post-harvest damage of grain, maintaining a low moisture content in the grain (14%) and storing at low temp. (22°C max.). [See FSTA (1976) 8 5M619 for part I.] STI

87

[Mycotoxins in milk and milk products.] Über toxische Schimmelpilzmetaboliten in Milch und Milchprodukten. [Lecture]

Brandl, E.

Wiener Tierärztliche Monatsschrift **63** (5) 166-171

(1976) [20 ref. De, en] [Inst. für Milchhygiene & Milchtech., Veterinärmed. Univ., Vienna, Austria]

88

Analysis of Blue cheese for roquefortine and other alkaloids from *Penicillium roqueforti*.

Scott, P. M.; Kennedy, B. P. C.

Journal of Agricultural and Food Chemistry **24** (4)

865-868 (1976) [16 ref. En] [Food Res. Div., Bureau of Chem. Safety, Food Directorate, Health Protection Branch, Health & Welfare Canada, Ottawa, Ontario K1A 0L2, Canada]

A method has been developed for the analysis of Blue cheese containing internal mould for the neurotoxin roquefortine and isofumigaclavines A and B, 3 alkaloids produced by *P. roqueforti*. Detection was by TLC and semiquantitative estimations were made for roquefortine and isofumigaclavine A. Recoveries of roquefortine added to cheese were 54-66%. Roquefortine was detected in 16 out of 16 samples of Blue cheese originating from 7 countries, in estimated concn. of ≤ 6.8 ppm. It was usually accompanied by isofumigaclavine A (up to an estimated 4.7 ppm) and traces of isofumigaclavine B were also detected in a few samples. Little or no migration of roquefortine into visibly nonmouldy areas of Blue cheese was observed. AS

89 OCHRATOXINS

Acute and short-term toxicity of ochratoxin A in 10-day-old chicks.

Galtier, P.; More, J.; Alvinerie, M.

Food and Cosmetics Toxicology 14 (2) 129-131

(1976) [16 ref. En] [Sta. de Pharmacologie-

Toxicologie, INRA, 180 Chemin de Tournefeuille, 31300 Toulouse, France]

Ochratoxin A is produced by *Aspergillus ochraceus* and *Penicillium viridicatum* and has been found as a natural contaminant in corn and barley. Prior tests have been acute and short-term, carried out on day-old chicks and broiler chickens, but this investigation involved oral administration of either a single dose or of 10 daily doses of ochratoxin to 10-day-old chicks. The LD₅₀ values found were 10.67 mg/kg for single doses and a total of 13.97 mg/kg for multiple doses. The similarity of the 2 LD₅₀ values suggests the possibility of accumulation of the toxin in the chick. VJG

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MYCOTOXINS IN FOODS

(EXCLUDING AFLATOXINS & MICROBIAL TOXINS)

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H. BROOKES
ASSISTANT EDITOR

1

Fungi and foods.

United States of America, Western New York State Institute of Food Technologists; **United States of America**, Cornell University, New York State Agricultural Experiment Station
Special Report, New York State Agricultural Experiment Station No. 13, 24pp. (1974) [36 ref. En]

Papers presented at the seventh annual symposium of the Western New York State Institute of Food Technologists, co-sponsored by Cornell University's New York State Agricultural Experiment Station, Geneva, USA, held in Rochester, New York on 19 Oct., 1972, were: Modification of fungi for food use, by D. C. Graham (pp. 4-7, 13 ref.); Mycotoxins - a review, by E. H. Marth (pp. 8-13, 12 ref.); Heat resistant moulds, by D. F. Splittstoesser (pp. 14-15, 11 ref.); Microbiology of spices, herbs and related materials, by P. A. Guarino (pp. 16-18); Fungi on fruits and vegetables for processing, by L. M. Massey, Jr. (pp. 19-21); and Control of mould by chemical preservatives, by F. Sauer (pp. 22-24). VJG

2

Evaluating the health significance of naturally-occurring food toxicants.

Friedman, L.

Abstracts of Papers, American Chemical Society 168, AGFD 74 (1974) [En] [Bureau of Foods, Div. of Toxicology, 200 C Street, SW, Washington, DC 20204, USA]

The importance of learning as early as possible the health consequences of the presence of mycotoxins in foods requires the elucidation of their toxic potential and the establishment of exposure levels that are consistent with human health. The problems of safety evaluation of unavoidable mould contaminants and the similarities and differences with evaluation of food additives and other components of food are discussed. AS

3

Conditions leading to mycotoxin contamination of foods and feeds.

Hesseltine, C. W.

Abstracts of Papers, American Chemical Society 168, AGFD 75 (1974) [En] [N. Regional Res. Lab., USDA, Peoria, Illinois 61604, USA]

To prevent toxigenic moulds from developing in foods and feeds requires an understanding of how moulds enter a commodity and then develop. Conditions affecting mould invasion can be divided into those existing during growth of the plant, at harvest, and after harvest. Invasion of the living plant by fungi is affected by amount of spore inoculum in the field, stresses on the plant,

invertebrate infections, damage by other fungi, plant varietal resistance, mechanical damage, mineral nutrition of the plant, and temp. During harvest, grain is exposed to mechanical damage and mould inoculum from air, soil, and harvesting equipment. After harvest, conditions affecting mould growth include moisture level of grain, temp. and humidity, rapidity of drying, amount of aeration, microbiological ecosystem, storage insects, mixing of grain, amount of chaff and dirt, chemical treatment of grain, degree of internal infection, accidental rewetting of grain by condensation or leakage, and development of hot spots. Conditions under which hot spots are believed to develop are reviewed. AS

4

The occurrence of mycotoxins in foods and feeds.

Stoloff, L.

Abstracts of Papers, American Chemical Society 168, AGFD 76 (1974) [En] [FDA, HFF-415, 200 C St., SW, Washington, DC 20204, USA]

This paper is concerned with the potential for encountering particular mycotoxins and the situations with which they may be associated. Natural occurrence of aflatoxins, citrinin, ergot, ochratoxin, patulin, penicillic acid, sporidesmin, sterigmatocystin, T-2 toxin, and zearalenone has been demonstrated. The vehicles have been raw agricultural commodities, e.g. nuts, grains, fruits, beans. Some contamination is associated with product abuse, some with apparently normal storage. Some contamination occurs in the field. These situations are explored toward the possibility of developing preventative measures. AS

5

Aspergillus toxins other than aflatoxin.

Cole, R. J.

Abstracts of Papers, American Chemical Society 168, AGFD 83 (1974) [En] [USDA, Nat. Peanut Res. Lab., PO Box 637, Dawson, Georgia 31742, USA]

Members of the genus *Aspergillus* represent some of the most prevalent mycotoxin-producing fungi isolated from commercial feed and food sources. *Aspergillus* mycotoxins, other than aflatoxins, and mycotoxin-producing species of *Aspergillus* are discussed in this review. Available physical, chemical, and biological data are presented for all known *Aspergillus* mycotoxins with major emphasis on the chemistry of those currently recognized as being of major economic importance. Included in this category are kojic acid, sterigmatocystins, and ochratoxins. Other *Aspergillus* mycotoxins presented are aspergillic acid, β -nitropropionic acid, flavutoxin, cytochalasin E, viriditoxin, oxalic acid, gliotoxin, helvolic acid, fumagillin, aspertoxin, maltoryzine, cyclopiazonic acid, ascladiol, austamide, terreic acid and terrein. AS

6

Patulin and penicillic acid.

Wilson, D. M.

Abstracts of Papers, American Chemical Society 168, AGFD 84 (1974) [En] [Dept. of Plant Pathol., Univ. of Georgia, Coastal Plain Sta., Tifton, 31794, USA]

The mycotoxins patulin, 4-hydroxy-4H-furo[3,2-c]pyran-2(6H)-one, and penicillic acid, 3-methoxy-5-methyl-4-oxo-2,5-hexadienoic acid, are lactone metabolites of several fungi, primarily species of *Aspergillus* and *Penicillium*. The chemical and physical properties, biosynthesis, and toxic effects of patulin and penicillic acid are briefly discussed. This review emphasizes recent work on analytical methods, natural occurrence, and stability in food and feeds. The effects of patulin and penicillic acid on DNA, RNA, and protein synthesis are also examined. The biological effects of orally ingested patulin and penicillic acid need further study to assess the potential health hazard of these compounds. AS

7

Penicillium toxins other than patulin and penicillic acid.

Pohland, A. E.

Abstracts of Papers, American Chemical Society 168, AGFD 85 (1974) [En] [FDA, Div. of Chem. & Physics, Bureau of Foods, 200 C St., Washington, DC 20240, USA]

The genus *Penicillium* includes a large number of species which produce toxic metabolites or mycotoxins. In many instances these species may be found universally on such stored food commodities as grains, meats and milk products. Many metabolites of penicillia are therapeutically useful; but a large number of the metabolites are acutely toxic and in some cases exhibit sub-acute toxicity (i.e. mutagenicity, teratogenicity or carcinogenicity). This review deals with those metabolites not known to have therapeutic value. The metabolites are grouped according to chemical structure and include quinones (monomeric and dimeric), methylene-quinones, nonadrides, unsaturated lactones, phenols and alkaloids. The chemistry, biochemistry and known toxicity of each structural type are discussed. AS

8

Potential mycotoxin problems in high moisture grain.

Columbic, C.

Annales de Technologie Agricole 22 (3) 435-447 (1973) [29 ref. En, fr, de] [USDA, Hyattsville, Maryland 20782, USA]

This paper, presented at the symposium 'Preservation of wet harvested grain' (held in Paris, France, 5-10 March 1973) gives brief details of studies conducted by the United States Agricultural Research Service. Aspects covered include: toxinogenic mould species which grow in grain; factors influencing mycotoxin formation (temp.,

moisture content, ventilation during storage, crop type); prevention and control of mycotoxin formation (prompt drying, ensilage, preservation with an acetic acid/propionic acid mixture); sampling of grain for mycotoxins; analytical methods for detection of aflatoxins in grain (the fluorescence method, the millicolumn method, the AOAC TLC method); decontamination of grain (physical separation methods, or treatment with NH_3 gas); and distribution of mycotoxins in milling fractions. AJDW

9

Production of the mycotoxin, zearalenone, by *Fusarium graminearum* growing on stored grain. II. Treatment of wheat grain with organic acids.

Sherwood, R. F.; Peberdy, J. F.

Journal of the Science of Food and Agriculture 25 (9) 1089-1093 (1974) [12 ref. En] [Dept. of Botany, Univ. of Nottingham, Nottingham NG7 2RD, UK]

The concn. of formic, acetic, propionic and butyric acids required to prevent growth of *Fusarium* in wheat grain cultures were determined. The cultures were maintained at 31% moisture content and stored for 4 wk at 25°C followed by 6 wk at 12°C, which were optimum conditions for growth of *Fusarium* and synthesis of the mycotoxin, zearalenone. Under these conditions the critical concn. of all the acids, whether used singly or in combination, was between 1000 and 10 000 ppm (equivalent to 0.1% and 1% w/w). At 1000 ppm and below the fungus was able to develop and zearalenone synthesis was not affected except where acetic acid was used alone, when higher toxin yields were recorded. AS

10

Production of the mycotoxin, zearalenone, by *Fusarium graminearum* growing on stored grain. I. Grain storage at reduced temperatures.

Sherwood, R. F.; Peberdy, J. F.

Journal of the Science of Food and Agriculture 25 (9) 1081-1087 (1974) [7 ref. En] [Dept. of Botany, Univ. of Nottingham, University Park, Nottingham NG7 2RD, UK]

The limiting conditions of grain moisture content (mc) and storage temp. for growth of *Fusarium* and production of the mycotoxin, zearalenone, were defined in maize, wheat, barley and oat culture. Grain mc was the major influence on establishment of the fungus, but storage temp. directly affected the rate of zearalenone synthesis. All the grains tested were susceptible to invasion by *Fusarium* above 18% mc (calculated on a wet wt. basis), even when stored at 7°C. In the range 15-18% mc the grain was increasingly at risk as the storage temp. was raised. Max. zearalenone yields (500-2000 µg/g grain) were obtained in cultures stored at 12 and 18°C, even though mycelial growth had been reduced. At 25°C, where there was rapid mycelial growth and almost total utilization of grain after 2 months' storage, toxin yields were seldom higher than 100 µg/g grain. AS

11

[A toxicity test for mycotoxins using the brine shrimp (*Artemia salina*).]

Yamamoto, K.; Tsubouchi, H.; Moriyama, S.; Sakabe, Y.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 15 (1) 11-17 (1974) [19 ref. Ja, en] [Health Res. Inst., 1-11 Hagiya-ma-cho, Mizuho-ku, Nagoya, Japan]

The aflatoxin B₁ toxicity test using the brine shrimp was modified. NaCl was added to sea water in a proportion of 1.7%. To 1 ml of this in a small evaporation dish, 20-30 newly-hatched brine shrimps were added and exposed to mycotoxin at 30°C for 24 h. The modified method was applicable to sterigmatocystin, diacetoxyscirpenol, T-2 toxin, fusarenone X and aflatoxins B₁ and G₁. [See also FSTA (1969) 1 7C302.] TM

12

[Contamination of foods by aflatoxins and other mycotoxins.] [Review]

Pantovic, D.; Adamovic, V. M.

Hrana i Iskrana 15 (1/2) 84-93 (1974) [58 ref. Sh, en] Zavod za Zdravstvenu Zastitut SRS, Belgrade, Yugoslavia]

13

Liquid chromatographic method for determination of patulin in apple juice.

Ware, G. M.; Thorpe, C. W.; Pohland, A. E.

Journal of the Association of Official Analytical Chemists 57 (5) 1111-1113 (1974) [10 ref. En] [Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

The apple juice sample is extracted with ethyl acetate and the extract is cleaned up by elution from a silica gel column with ethyl acetate-benzene. Patulin is determined by use of a liquid chromatography, a 25 cm Zorbax-Sil column, and a 254 nm UV detector. This method has a lower detection limit of 11 µg/l. with recoveries of patulin added to apple juice >85%. GLC-MS analysis of the acetate derivative is used for confirmation. Patulin was detected at levels ranging from 44 to 309 µg/kg in 8 of 13 commercial samples of apple juice. AS

14

[Patulin in products of cider manufacture.]

Drilleau, J. F.; Bohuon, G.

Comptes Rendus Hebdomadaires des Seances de l'Academie d'Agriculture de France 59 (13) 1031-1036 (1973) [13 ref. Fr] [INRA, Sta. de Recherches Cidricoles, 35042 Rennes Cedex, France]

Patulin was determined in the juice of healthy and decayed apples, in industrially produced apple juice and in farm- and industrially-produced cider. No patulin was found in juice from healthy fruit, and approx. 0.5 ppm in juice from decayed apples.

8 industrially-produced apple juices and 2 concentrates contained no patulin. Of 8 farm-produced and 5 industrial ciders, 3 farm and 1 industrial product contained no patulin, 3 farm and 3 industrial products contained approx. 0.1 ppm, and 2 farm and 1 industrial product 0.3 ppm. Patulin remained stable in juice from decayed apples during 10 min heating at 90°C and for 20 min at 80°C when added to apple juice, suggesting that heat treatment during cider production would not destroy any toxin present. It could be reduced by addition of SO₂ before fermentation. RM

15

[The importance of patulin in the production of fruit juices.] Die Bedeutung von Patulin bei der Herstellung von Fruchtsäften. [Review] Frank, H. K.

Flüssiges Obst 41 (8) 330-331 (1974) [10 ref. De] [Bundesforschungsanstalt für Lebensmittelrisikoforschung, Karlsruhe, Federal Republic of Germany]

This brief review is a summary of part of a paper on mould formation in fresh fruit and processed fruit products presented at the 1974 meeting of the Federal Fruit and Vegetable Processing Association (Bundesverband der Obst- und Gemüseverwertungsindustrie eV) in Munich. SKK

16

[The problem of mycotoxins in the production and processing of groundnuts and pecans in the USA.] Mykotoxinprobleme bei der Produktion und Verarbeitung von Erdnüssen und Baumüssen in den USA. [Review]

Escher, F.

Lebensmittel-Wissenschaft + Technologie 7 (5) 255-260 (1974) [42 ref. De, en] [Inst. für Lebensmittelwissenschaft, Eidgenössische Tech. Hochschule, Universitätstrasse 2, 8006 Zürich, Switzerland]

17

Isolation, detection, and quantitation of zearalenone in maize and barley.

Mirocha, C. J.; Schauerhamer, B.; Pathré, S. V.

Journal of the Association of Official Analytical Chemists 57 (5) 1104-1110 (1974) [6 ref. En] [Dept. of Plant Pathol., Univ. of Minnesota, St. Paul, Minnesota 55101, USA]

A versatile method for detection of zearalenone is described, employing options of either TLC, GLC, UV chromatography, GLC-MS, or combinations of all these. Zearalenone is extracted with either a Soxhlet apparatus or the more rapid and convenient batch extraction technique with equal efficiency. Cleanup of extract involves either base (NaOH) treatment and partition with water or acetonitrile-petroleum ether partition. A chloroform-ethanol (97 + 3) solvent system is used for analysis by TLC with confirmation by

fluorescent properties. The limit of detection on TLC plate is 0.1 µg, while sensitivity for the TLC method is about 50 parts/billion. Best quantitative results are obtained by analytical procedures involving GLC. The limit of sensitivity by GLC is <50 parts/billion. The derivatives dimethoxyzearalenone and methyl oxime-di-TMS-zearalenone are prepared to confirm presence of zearalenone. Zearalenone can also be analysed both qualitatively and quantitatively by UV spectrophotometry. For quantitation, a standard curve is constructed of absorption at 274 nm. The limit of detection is between 0.1 and 0.5 µg/ml. Analysis by combination GLC and MS is also described along with analysis by multiple ion detection. % recovery is 83.5 ± 7 . The method described is suitable for analysis of concentrations of zearalenone normally encountered in nature and thought to be significant. AS

18

Rabbit skin test for estimation of T-2 toxin and other skin-irritating toxins in contaminated corn.
Chung, C. W.; Trucksess, M. W.; Giles, A. L., Jr.; Friedman, L.

Journal of the Association of Official Analytical Chemists 57 (5) 1121-1127 (1974) [17 ref. En] [FDA Washington, DC 20204, USA]

A rabbit bioassay test has been developed which can be used for screening large numbers of field samples of corn for T-2 and other toxins. 2 µl each of the control solutions, 0.005-0.12 µg standards, and about 12 samples in ethyl acetate were applied simultaneously to the closely clipped skin of a 2-3 kg young rabbit. The skin reactions were read at 24, 48, and 72 h. The prominent features of the reactions were erythema, oedema, and necrosis. The T-2 toxin equivalences of the samples were estimated by the degree of the skin reactions caused by the standards. The method is reliable to at least 0.01 µg/test or 50 parts/billion. Graded response to the toxin is dependent upon the use of sensitive animals and properly diluted samples and standards. Rabbits were more sensitive than weanling rats or young guinea pigs, and the method showed better reproducibility with rabbits. Citrinin and zearalenone (F-2) showed negative skin reactions when applied at a level of 20 µg/skin site. They also showed skin reactions when administered by intradermal injection into rabbit skin. However, all 3 mycotoxins showed distinct skin reactions in guinea pigs by the intradermal route. The test was as sensitive as the topical test using rabbits with T-2 toxin. The prominent feature of the skin reaction was induration. AS

19

Mycotoxin-producing potential of fungi isolated from cheese.

Gaddi, B. L.

Dissertation Abstracts International, B 34 (10) 5012: Order no. 74-482 (1974) [En] [Univ. of Wisconsin, Madison 6, USA]

144 moulds, isolated from naturally-ripened cheeses, were screened for their ability to produce fluorescent compounds in agar media, and to inhibit *Bacillus megaterium* and primary monkey kidney cells. Of 10 moulds that markedly inhibited *B. megaterium*, only 1 (an *Aspergillus* sp.) produced compounds toxic to *B. megaterium* when inoculated into mild Cheddar cheese and incubated at room temp. for 1 and 3 wk. Toxic products produced by the 10 moulds at 28°C in yeast extract/sucrose medium were not destroyed by autoclaving for 4 h, but were destroyed by addition of acid, alkali or H₂O₂. The IR spectra of some of the compounds were determined and analysed; none resembled aflatoxins. CDP

20

Some conditions favouring production of ochratoxin A and citrinin by *Penicillium viridicatum* in wheat and barley.

Harwig, J.; Chen, Y.-K.

Canadian Journal of Plant Science 54 (1) 17-22 (1974) [29 ref. En, fr] [Food Res. Lab., Health Protection Branch, Ottawa, Ontario K1A 0L2, Canada]

Wheat, ground wheat, barley, and heat-treated wheat and barley were inoculated with different strains of *Penicillium viridicatum* Westling and incubated under different conditions of moisture content, RH, temp., and time. An important factor for production of ochratoxin A and citrinin was humidity. A water activity (*a_w*) of 0.90-0.93 produced high concn. of the mycotoxins. Below this *a_w* the native mycoflora developed along with *P. viridicatum* and concn. of the mycotoxins were significantly lower. A temp. of 5°C did not prevent production of the toxins under conditions of high *a_w* and extended storage. Viable barley (*Hordeum vulgare* L.) and wheat seed (*Triticum aestivum* L.) were less prone to mycotoxin production than nonviable seed. Samples exposed for short periods to conditions most favourable for *P. viridicatum* were not visibly mouldy but contained ochratoxin A. AS

21

Production of patulin by *Penicillium expansum*.
Sommer, N. F.; Buchanan, J. R.; Fortlage, R. J.
Applied Microbiology 28 (4) 589-593 (1974) [17
ref. En] [Dept. of Pomology, Univ. of California,
Davis, California, 95616, USA]

In vivo and in vitro formation of the mycotoxin patulin by a total of 27 isolates of *P. expansum* from apples, crabapples, grapes, pears, apricots and persimmons from Europe, Australia and North America was studied. Patulin concn. were evaluated by TLC or by inhibition of *Bacillus megaterium*. In vitro cultures produced 10 µg-1 mg patulin/ml; in vivo cultures on apples gave patulin concn. of 2-125 µg/g. All isolates produced patulin. Storage at 0°C did not prevent patulin formation in apples infected with *P. expansum*; storage of infected apples in low-O₂ and/or high-CO₂ atm markedly reduced patulin formation; it is therefore concluded that controlled atm storage and transport of deciduous fruit might reduce the patulin hazard. AJDW

22

[Mycotoxins.] Mykotoxine.
Lienert, E.

Wiener Tierärztliche Monatsschrift 61 (8/9) 237-240 (1974) [De, en] [Pharmakologisches Inst., Tierärztliche Hochschule, Vienna, Austria]

The following mycotoxins are considered from the viewpoint of the clinical syndromes they produce in animals, potential dangers to man being mentioned: ergot alkaloids, lactones, dicoumarol, ochratoxins, aflatoxins, rubratoxins, zearalenone, sterigmatocystin, kojic acid, and aspergillilic acid. Occurrence in cereals and cereal products, nuts, sausages, ham, legumes, oats, rice, fats, milk and cheese is tabulated. SKK

23

***Penicillium viridicatum* mycotoxicosis in the rat. IV. Attempts to modify the tissue responses.**

McCracken, M. D.; Carlton, W. W.

Food and Cosmetics Toxicology 12 (3) 331-340 (1974) [7 ref. En, fr, de] [Dept. of Vet. Microbiol. & Pathol., School of Vet. Sci. & Med., Purdue Univ., W. Lafayette, Indiana 47907, USA]

See FSTA (1974) 6 10M1404 for part III.

24

Citrinin mycotoxicosis in beagle dogs.

Carlton, W. W.; Sansing, G.; Szczech, G. M.

Food and Cosmetics Toxicology 12 (4) 479-490 (1974) [13 ref. En, fr, de] [Dept. of Vet. Microbiol. & Pathol., School of Vet. Sci. & Med., Purdue Univ., W. Lafayette, Indiana, USA]

3 trials were carried out in which young beagle dogs were either fed a citrinin-containing culture of *Penicillium citrinum*, or were administered pure citrinin either ip or orally. Dogs fed the fungal

culture and those given 20 or 40 mg pure citrinin/kg body wt. developed renal disease. Dogs given 2.5 and 5 mg/kg remained clinically normal and without renal lesions. Clinical, clinical-pathological and pathological features of citrinin mycotoxicosis in young beagle dogs are reported. VJG

25

[Gas liquid chromatography of trichothecene mycotoxins.]

Tanaka, K.; Amano, R.; Kawada, K.; Tanabe, H.
Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 15 (3) 195-200 (1974) [22 ref. Ja, en] [Meiji Pharmaceutical Coll., Nozawa-cho 1-chome, Setagaya-ku, Tokyo, Japan]

An analytical method for trichothecenes, the toxic metabolites of *Fusarium* sp., is described. Using a mixture of N-trimethylsilyl imidazole, trimethyl chlorosilane and pyridine as silylating reagents, the trichothecenes are easily and completely converted to trimethylsilyl ethers. SE-30 as well as OV-17 was the most suitable liquid phase for detection and detn. of trimethylsilyl ethers of trichothecenes by GLC. TM

26

Long-term administration of sterigmatocystin and *Penicillium viridicatum* to mice.

Zwicker, G. M.; Carlton, W. W.

Food and Cosmetics Toxicology 12 (4) 491-497 (1974) [20 ref. En, fr, de] [Dept. of Vet. Microbiol. & Pathol., School of Vet. Sci. & Med., Purdue Univ., W. Lafayette, Indiana 47907, USA]

Effects of long-term feeding (54-58 wk) of (i) pure sterigmatocystin, (ii) sterigmatocystin in the form of a rice culture of *Aspergillus versicolor* and (iii) a toxic rice culture of an Indiana isolate of *Penicillium viridicatum*, were studied by feeding male and female white Swiss mice on a diet containing 5 ppm (i) or (ii) and/or a 7.5% content of (iii) for 2 wk alternating with 2 wk periods on the control diet. Incidence of pulmonary tumours in mice fed (i), (ii) and (iii) was respectively 73, 49 and 16% higher than that in the control group. The presence of common mycotoxins in (iii) was eliminated by chemical analysis. It was concluded that (iii) and (i) or (ii) had a carcinogenic effect when fed in the diet to mice but no additive effect was found when sterigmatocystin was combined with the (iii) diet. VJG

27

Acute intraperitoneal toxicity of ochratoxin A and B derivatives in rainbow trout (*Salmo gairdneri*). Doster, R. C.; Sinnhuber, R. O.; Pawlowski, N. E. *Food and Cosmetics Toxicology* 12 (4) 499-505 (1974) [15 ref. En, fr, de] [Dept. of Food Sci. & Tech., Oregon St. Univ., Corvallis, Oregon, USA]

The acute ip toxicities of 5 derivatives of ochratoxins A and B, metabolites of *Aspergillus ochraceus*, were determined using 6-month-old Mt. Shasta strain rainbow trout as test animals. Ethyl esters of ochratoxins A and B were lethal to trout when administered in corn oil. The 10-day LD₅₀ values of ochratoxin A and B ethyl esters were 3.0 and 13.0 mg/kg body wt, respectively. Ochratoxins A and B, the ip toxicities of which were previously determined in rainbow trout in another study, were again administered in this study under the current experimental conditions. The LD₅₀ of ochratoxin A was 5.53 mg/kg body wt. (13.72 µmols/kg), while ochratoxin B caused no deaths at a dose of 66.7 mg/kg body wt. The ethyl ester of ochratoxin A administered ip in corn oil, and the alanine and leucine analogues of ochratoxin A administered in aqueous bicarbonate, were not lethal to trout at a dose level of 13.72 µmols/kg body wt. (the LD₅₀ of ochratoxin A). Histopathological damage caused by these toxins in the trout liver and kidney is described. AS

28

Stability of ochratoxin A in beans during canning. Harwig, J.; Chen, Y.-K.; Collins-Thompson, D. L. *Canadian Institute of Food Science and Technology Journal* 7 (4) 288-289 (1974) [21 ref. En] [Res. Div., Bureau of Microbial Hazards, Health Protection Branch, Ottawa, Ontario, Canada]

Soaking and blanching of artificially-infected mouldy beans (*Phaseolus vulgaris*) resulted in an average loss of ochratoxin A of 21 and 10% respectively. Canned beans contained 64% of the total ochratoxin A amount before heating and 53% after 1 h of heating at 121°C. This 11% reduction was not significant by the 't' test. This 1 h treatment was comparable to that recommended for processing beans in tomato sauce. After heating for 4 h there was a 34% reduction in ochratoxin A content (P<0.10). AL

29

The occurrence of ergosta-4,6,8(14),22-tetraen-3-one in several fungi.

Price, M. J.; Worth, G. K.

Australian Journal of Chemistry 27 (11) 2505-2507 (1974) [8 ref. En] [Agric. Chem. Lab., Dept. of Agric., Stock & Fisheries, PO Box 1863, Boroko, Papua, New Guinea]

Ergosta-4,6,8(14),22-tetraen-3-one was identified in extracts of rice infected with *Aspergillus*, *Penicillium* and *Fusarium* spp. AS

30

Mold growth and mycotoxin production on aged hams and sausages. [Conference proceedings]

Ayres, J. C.; Leistner, L.; Sutic, M.; Koehler, P. E.; Wu, M. T.; Halls, N. A.; Strzelecki, E.; Escher, F. *IV International Congress of Food Science and Technology Abstracts of Papers 9a*, 204-205 (1974) [En] [Food Sci. Dept., Univ. of Georgia, Athens, Georgia 30602, USA]

Toxigenic strains of *Aspergillus flavus*, *A. parasiticus*, *A. ochraceus*, *A. wentii*, *A. versicolor* and *Penicillium viridicatum* were detected in country cured hams and fermented sausages stored at ambient summer temp. Also, it was possible to demonstrate that under suitable conditions, aflatoxins, ochratoxins, sterigmatocystins, *A. wentii* toxin and citrinin could be produced. Apparently, mycotoxin production occurs when the aging temp. increases to 20° to 30°C but before the available water of the hams becomes too low to permit growth of the toxic moulds. Conversely, low temp. (10°C) and low humidities (65 to 70%) during aging as well as high salt concn. on the hams prevent growth and mycotoxin production. AS

31

Effect of low level gamma irradiation on growth and patulin production by *Penicillium patulum*.

Bullerman, L. B.; Hartung, T. E.

Journal of Food Science 40 (1) 195-196 (1975) [14 ref. En] [Dept. of Food Sci. & Technol., Univ. of Nebraska, Lincoln, Nebraska 68503, USA]

Spores and vegetative mycelia of 2 strains of *Penicillium patulum* were irradiated at 100 and 200 Krad to determine the effects on growth and patulin production. Irradiation of spores reduced subsequent growth in potato dextrose broth by both strains. Spores of one strain were more resistant to irradiation than spores of the second strain. Irradiation of mycelia resulted in a variable growth response in subsequent cultures in potato dextrose broth. Cultures grown from irradiated spores and mycelia produced less patulin than nonirradiated control cultures. There was a marked reduction in the amount of patulin produced per mg of dry mycelia with both strains when grown from either irradiated spores or mycelia. IFT

32

Toxic fungal polyketides in the food chain.

[Conference proceedings]

Hsieh, D. P. H.

IV International Congress of Food Science and Technology Abstracts of Papers 9a, 205 (1974)

[En] [Dept. of Environmental Toxicology, Univ. of California, Davis, California, USA]

A number of fungal polyketides, biogenetically all derived from acetate via the polyketide, or

acetate polymalonate pathway, are important foodborne mycotoxins. Some of them, when ingested by animals, are metabolically activated to form extremely potent carcinogens, which become incorporated into edible animal tissues or products. The important toxigenic fungi include *Aspergillus*, *Penicillium*, *Fusarium*, *Claviceps*, *Pithomyces*, and *Stachybotrys*. The same polyketide pathway for the synthesis of a specific group of mycotoxins may exist in more than one fungal genus. In addition, the biogenetic intermediates of a mycotoxin may also become mycotoxins. The biogenetic unity in the fungal polyketide pathways offers the possibility of controlling the polyketide mycotoxin problems at the source. AS

33

Quantitative analysis of patulin in apple juice.

Rosen, J. D.; Pareles, S. R.

Journal of Agricultural and Food Chemistry 22 (6) 1024-1026 (1974) [8.ref. En] [Dept. of Food Sci., Cook College, Rutgers Univ., New Brunswick, New Jersey 08903, USA]

A method for the quantitative analysis of patulin in apple juice has been developed. The technique is based on mass fragmentographic detection of the parent (P) ion of the silylated patulin derivative. Sensitivity of the method is estimated at 1 ppb and no cleanup is required. Confirmation of identity at 10 ppb but not at 1 ppb is achieved by simultaneous monitoring of the P and P + 1 ions. AS

34

Occurrence of aflatoxins and citrinin in groundnut (*Arachis hypogaea* L.) at harvest in relation to pod condition and kernel moisture content.

Subrahmanyam, P.; Rao, A. S.

Current Science 43 (22) 707-710 (1974). [16 ref. En] [Microbiol. Lab., Dept. of Botany, S. V. Univ., Tirupati 517502, Andhra Pradesh, India]

Groundnut pods were collected from fields on the day of harvest, graded into damaged and undamaged pods and kernel moisture was determined. A yellow pigment in some kernels, especially damaged pods, was identified as citrinin. Only *Aspergillus flavus* isolates were found to produce aflatoxins while isolates of *Penicillium citrinum*, *P. jensenii* and *Asp. terreus* produced citrinin. Aflatoxin and citrinin levels were high in kernels containing <30% moisture (rain-fed conditions), but little or no mycotoxin formation occurred when kernel moisture content was high (irrigation conditions). All damaged kernels were found to contain toxins. AL

35

Patulin, a mycotoxin, in fruit products.

[Conference proceedings]

Sommer, N. F.; Buchanan, J. R.; Fortlage, R. J.; Hsieh, D. P. H.

IV International Congress of Food Science and Technology Abstracts of Papers 9a, 209 (1974)

[En] [Dept. of Pomology, Univ. of California, Davis, California 95616, USA]

The deciduous fruit blue fungus, *Penicillium expansum* Lk. ex Fr., produced patulin, a mycotoxin, in all fruits tested. Fungus strains isolated from various fruit hosts in Australia, Europe, and North America all produced patulin, though the concn. produced in apples differed 60-fold. The patulin concn. in blue fungus lesions were highest in apples and lowest in plums (intermediate in cherries, apricots, peaches and pears). Patulin concn. were generally closely related to the amount of fungus growth, with the patulin usually strictly confined to the lesions. Low temp. of refrigerated fruit storages suppressed patulin production primarily by slowing fungus growth rather than by interfering with synthesis. AS

36

Detection of ochratoxin A in barley, using silica gel minicolumns.

Hald, B.; Krogh, P.

Journal of the Association of Official Analytical Chemists 58 (1) 156-158 (1975) [15 ref. En] [Inst. of Hygiene and Microbiol., Royal Vet. and Agric. Univ., DK-1870 Copenhagen V., Denmark]

A simplified procedure has been developed to detect ochratoxin A in cereals which can be used in the field where equipment for TLC is not available. The procedure includes extraction of the acidified sample with chloroform, purification over NaHCO_3 and minicolumn chromatography. Under longwave UV light ochratoxin A appears as a blue-green fluorescent band at the lower end of the column. Contamination levels as low as 12 ppb can be detected by this method. AS

37

Rapid screening method for aflatoxins and zearalenone in corn.

Thomas, F.; Eppley, R. M.; Trucksess, M. W.

Journal of the Association of Official Analytical Chemists 58 (1) 114-116 (1975) [11 ref. En] [Div. of Chem. and Physics, FDA, Washington, DC 20204, USA]

The methanol-water extraction system used in AOAC Method II for aflatoxins, extracts both the aflatoxins and zearalenone from corn. Using this methanol-water extraction system as a base, a rapid screening procedure has been developed for these mycotoxins. The methanol-water extract is defatted with hexane and the pigments are precipitated with copper carbonate. The aflatoxins and zearalenone are subsequently extracted into chloroform and are then detected by half-plate TLC. An elapsed time of about 1 h is required to analyse 1 sample. The sensitivity of the method is about 2 $\mu\text{g/kg}$ for aflatoxin B₁ and 100 $\mu\text{g/kg}$ for zearalenone. AS

38

Determination of penicillic acid and patulin by gas-liquid chromatography with an electron-capture detector.

Fujimoto, Y.; Suzuki, T.; Hoshino, Y.

Journal of Chromatography **105** (1) 99-106 (1975) [6 ref. En] [Inst. of Public Health, Kamiokubo, Urawa, Japan]

Quantitative and concurrent determinations of (i) penicillic acid and (ii) patulin were achieved after separation of these compounds, as their trimethylsilyl derivatives, by GLC with electron-capture detection and a column of 10% of DC-200 plus 15% of QF-1 on Gas-Chrom Q; min. determinable amounts of (i) and (ii) were 0.05 and 0.1 ng, respectively. The procedure for determining these compounds in grain involves extraction with solvents, followed by further clean-up by TLC; the about 90%. The significant separation of (i) and (ii) produced in mouldy rice is demonstrated on the gas chromatograms, and this makes possible a micro-assay for these toxic compounds in contaminated grain. AS

39

[Chemical analysis of mycotoxin. IV.

Determination of sterigmatocystin in grain.]

Takeda, Y.; Isohata, E.; Amano, R.; Tanabe, H.; Kurata, H.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] **15** (5) 363-367 (1974) [7 ref. Ja, en] [Nat. Inst. Hyg. Sci., 18-1, Kamiyoga 1-chome, Setagaya-ku, Tokyo, Japan]

Methods for detn. of sterigmatocystin in grain were studied. The mycotoxin was extracted from the grain with a mixture of methanol and 1% NaCl solution and reextracted with chloroform. After clean-up by silica gel column chromatography, it was detected and quantitatively estimated by TLC. The quantitative analytical procedure was based on the conversion of sterigmatocystin to a more highly fluorescent derivative by spraying a 20% AlCl_3 ethanol solution on a developed chromatogram. [See FSTA (1974) 6 5J571 for part III.] TM

40

Grain preservatives: effect on aflatoxin and ochratoxin production.

Vandegrift, E. E.; Heseltine, C. W.; Shotwell, O. L.

Cereal Chemistry **52** (1) 79-84 (1975) [10 ref. En] [N. Regional Res. Lab., Peoria, Illinois 61604, USA]

Corn was treated with either 2% ammonia or 1% propionic acid. Both ammonia and propionic acid significantly reduced mould growth and subsequent aflatoxin and ochratoxin formation. Growth and the formation of mycotoxins were inhibited more by propionic acid than by ammonia. Both ammonia and propionic acid remained effective in inhibiting mould growth and aflatoxin production and in preventing ochratoxin production when treated corn stood as long as 19 and 29 wk, respectively, before inoculation. AS

41

[Determination of ochratoxin A.] Zur Bestimmung von Ochratoxin A.

Fritz, W.; Donath, R.

Nahrung **18** (8) 827-832 (1974) [18 ref. De, en, ru] [Zentralinst. für Ernährung, Potsdam-Rehbrücke, German Democratic Republic]

A method for detection and semiquantitative detn. of ochratoxin A in foods is described. After extraction with chloroform and preliminary cleanup, ochratoxin A is separated by TLC on Kieselgel G, using an ether/methanol/water (5:4:2, v/v) mixture. Ochratoxin A spots are identified by their UV fluorescence characteristics, and the concn. may be semiquantitatively estimated by UV excitation and fluorescence spectrophotometry directly on the TLC plate. Recovery is $\leq 90\%$, and the detection limit is 5-30 $\mu\text{g/kg}$ (depending on the food under test). The method is also applicable to detection and detn. of ochratoxins B and C. AJDW

42

[A new TLC method for determination of patulin.]

Ein neuer dünnschichtchromatischer Nachweis für Patulin.

Meyer, R. A.

Nahrung **19** (1) K1-K2 (1975) [6 ref. De] [Hygiene Inst., Inspektion Ernährungshygiene, Dresden, German Democratic Republic]

After a brief discussion of published methods for TLC detection of the mycotoxin patulin in foods, (UV fluorescence methods, or reaction with o-dianisidine), a new method is described. Patulin is separated by TLC on Kieselgel G, using a chloroform/acetone (68:32, v/v) mixture. The TLC plate is then sprayed with a 0.2% solution of o-phenylenediamine in n-propanol/20% H_2SO_4 (1:1, v/v), and heated for 15 min at 130°C. Patulin spots are detected by their green fluorescence in long-wavelength UV light. The detection limit is 10 ng patulin. AJDW

43

Collaborative study of a method for the determination of ochratoxin A in green coffee.

Levi, C. P.

Journal of the Association of Official Analytical Chemists **58** (2) 258-262 (1975) [4 ref. En] [General Foods Corp., Tech. Center, White Plains, New York 10623, USA]

A method for the semiquantitative detn. of ochratoxin A in green coffee has been studied collaboratively by 11 laboratories. The average recovery for the 7 samples spiked at 3 levels of ochratoxin A was 69.1%, ranging from 60.5 to 85.6%. This is comparable to other visual TLC methods of mycotoxin detection. The method has been adopted as official first action for the detn. of ochratoxin A in green coffee beans. AS

44

[Detection of patulin in apple juice.] Zum Nachweis von Patulin in Apfelsaft. Eyrich, W.

Chemie Mikrobiologie Technologie der Lebensmittel 4 (1) 17-19 (1975) [11 ref. De, en, fr] [Chem. Landesuntersuchungsanstalt, Karlsruhe, Federal Republic of Germany]

Detection of patulin in apple juice is accomplished by thin layer separation of an ethyl acetate extract purified by column chromatography. To make the patulin visible 3-methyl benzothiazolone-2-hydrazonehydrochloride is used. The detection limit was not the same in all samples and fluctuated between 0.025 and 0.1 ppm. In 40 commercially available apple juices the patulin content was below the detection limit. AS

45

[Chromatographic determination of the toxicity of grain infected with *Fusarium sporotrichiella*.]

Olifson, L. E.; Kenina, Sh. M.; Kartashova, V. L.; Galkovich, K. G.

Voprosy Pitaniya No. 2, 83-86, 95 (1975) [6 ref. Ru, en] [Orenburgskii Med. Inst., USSR]

A chromatographic method for determining the toxicity of cereals affected by the micromycetes *F. sporotrichiella* is proposed. The method is based on separation of the lipids extracted from the grain in a thin layer of silica gel and detection on the chromatogram of 2 toxic fractions of R_f 0.06 and 1.22 which fluoresce in UV-light by emission of greyish-green and emerald-green light. The chromatographic method is more sensitive and quicker than biological methods, and gives visually obvious results. AS

46

[Prevention of mould growth on cheese during ripening.] [Lecture]

Dijcman, - van

Alimentaria 11 (58) 43-44, 47 (1974) [Es]

The production of mycotoxins is discussed and the importance of the potential health hazards of mould growth on cheese is emphasized in addition to the financial losses and wastage involved. Standard methods of preventing mould growth are considered. Wrapping of cheese before ripening in plastics material is now an important method of preventing mould growth and retaining moisture, but possible disadvantages are high cost, liability to tearing and interference with normal ripening. The use of fungicides, preferably applied in a plastics emulsion which also retains moisture and permits good ripening is recommended; penetration of the fungicide, e.g. sorbic acid, is about 0.8 mm. ELC

47

Mycotoxin producing-potential of molds isolated from Cheddar cheese.

Bullerman, L. B.; Olivigni, F. J.

Journal of Food Science 39 (6) 1166-1168 (1974) [22 ref. En] [Dept. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, Nebraska 68503, USA]

Surface mould counts of 7 brands of Cheddar cheese were generally higher at 21° than at 5°C; they ranged (per g surface material) from 'none detected' to 1440 and from 6 to 3190 at the 2 temp. respectively in aged cheeses, and from 5 to 3380 and 7 to 3500 in mild cheeses. Moderate to very extensive mould coverage became visible within 6 wk at 5°C, except in the case of 1 cheese which had been treated with potassium sorbate. Mould counts of 2 brands of shredded Cheddar cheese were very low at both temp. A total of 349 isolates were predominantly *Penicillium* spp. (287 isolates) and *Aspergillus* spp. (23); 29.5 and 47.8% of the isolates of these 2 genera respectively were toxic to chicken embryos, and 21.6 and 21.7% were toxic to *Bacillus megaterium*. All the toxinogenic aspergilli were from plates incubated at 21°C, whereas >50% of the toxinogenic penicillia were from plates incubated at 5°C. No tests were made to determine whether toxins had been produced by the organisms whilst growing in the cheese. CDP

48

[Simultaneous analysis for penicillic acid and patulin in cereals.]

Suzuki, T.; Fujimoto, Y.; Watanabe, A.; Nose, N.; Hoshino, Y.; Kobayashi, S.; Tanaka, A.; Kikuchi, Y.; Sugaya, A.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 15 (4) 280-285 (1974) [14 ref. Ja, en] [Saitama Inst. Public Health, Kamiookubo-higashi, Urawa-shi, Japan]

A method for simultaneous determination of penicillic acid and patulin was investigated. Powdered cereals or soybeans were soaked in a mixed solution of methanol and 5% NaCl solution for primary extraction of the compounds, followed by washing with n-hexane and secondary extraction with ethyl acetate, and determinations by TLC and gas liquid chromatography. For each compound the detection limit was 0.2 ppm.; recoveries by GLC were 75-88% for penicillic acid and 73-80% for patulin. TM

49

[Studies on the population of toxigenic fungi in foodstuffs. VIII. Toxicological properties of *Fusarium* spp.]

Koh, C. M.; Kim, S. J.; Cho, S. H.; Kim, S. K.; Lew, J.

Korean Journal of Microbiology 12 (2) 59-68 (1974) [22 ref. Ko, en] [Dept. of Microbiol., Coll. of Med., Yonsei Univ. Seoul, Korea]

Of 5 *Fusarium* spp. isolated from cereals, 3 were highly toxic to mice, causing liver injury. The isolates were suspected of producing toxic fusarenone-X. The skin-necrotizing effect in mice could be used for screening toxin-producing fungi.

KoSfOST

50

[Toxic substances in infected cereals. III. Acute toxicities of new trichothecene mycotoxins: deoxynivalenol and its monoacetate.]

Yoshizawa, T.; Morooka, N.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 15 (4) 261-269 (1974) [21 ref. Ja, en] [Fac. of Agric., Kagawa Univ., Mikicho, Kita-gu, Kagawa-ken, Japan]

The acute toxicities of (i) deoxynivalenol and (ii) its monoacetate were compared with those of (iii) nivalenol and (iv) fusarenone. The LD₅₀ values of (i), (ii), (iii) and (iv) in intraperitoneally administered male mice were 70, 49, 6.9 and 5.6 mg/kg, respectively. The oral LD₅₀ values in male mice were 46 mg/kg for (i) and 5.5 mg/kg for (iv). These facts suggested that the C-4 hydroxyl group which is not contained in (i) and (ii) may play an important role in the mammalian toxicity of trichothecenes. The subcutaneous min. doses of (i) and (ii) for vomiting and diarrhoea in dogs were 0.1 and 0.2 mg/kg, respectively. The 4 toxins showed marked cytotoxicity to protozoan, *Tetrahymena pyriformis* W and cultured mammalian cells. TM

51

A procedure for the extraction and estimation of rubratoxin B from corn.

Hayes, A. W.; McCain, H. W.

Food and Cosmetics Toxicology 13 (2) 221-229 (1975) [18 ref. En] [Dept. of Microbiol., Univ. of Alabama, Alabama 35486, USA]

In absence of any detection or assay procedure it has only been possible to infer the presence of the mycotoxin rubratoxin B, a hepatotoxin elaborated by *Penicillium rubrum*, in agricultural commodities. A simple method is reported for determining rubratoxin B in corn. The toxin was extracted with ethyl acetate, the extract concentrated, aliquots applied to silica-gel TLC plates which were developed in unlined tanks with ascending methanol-chloroform-glacial acetic acid-water (20:80:1:1, by vol.), and heated at 200°C for 10 min. A distinctive fluorescent derivative of rubratoxin B was then observed under long-wave UV light. Under the conditions used the lower limit of detection for rubratoxin was 0.5 µg. VJG

52

[Studies on the population of toxigenic fungi in foodstuffs. VII. Toxicological properties of *Penicillium* spp. isolated from foodstuffs.]

Koh, C. M.; Kim, S. K.; Cho, S. H.; Kim, S. J.; Choi, T. J.; Lew, J.

Korean Journal of Applied Microbiology and Bioengineering 2 (1) 19-27 (1974) [50 ref. Ko, en] [Dept. of Microbiol., Coll. of Med., Yonsei Univ., Seoul, Korea]

Culture filtrates of 31 *Penicillium* spp. isolated from foodstuffs were tested for toxicity toward HeLa cell cultures and ICR-mice. 9 strains were cytotoxic toward HeLa cell cultures and 7 strains were toxic toward ICR-mice, causing liver injury. Cytotoxicity test with HeLa cells is feasible as a mass screening method for mycotoxin-producing fungi.

KoSfOST

53

Purification and characterization of roseotoxin B, and toxic cyclodepsipeptide from *Trichothecium roseum*.

Engstrom, G. W.; DeLance, J. V.; Richard, J. L.; Bactz, A. L.

Journal of Agricultural and Food Chemistry 23 (2) 244-253 (1975) [61 ref. En] [Nat. Animal Disease Center, Vet. Sci. Res. Div., USDA, Ames, Iowa 50010, USA]

Roseotoxin B, a new mycotoxin isolated from ether extracts of *Trichothecium roseum*, was purified and characterized. It is a cyclodepsipeptide with a mol. wt. of 591 and an empirical formula of C₃₀H₄₉O₇N₅. It consists of 1 mol each of L-isoleucine, N-methylvaline, N-methylalanine, trans-3-methyl-L-proline, β-alanine, and 2-hydroxy-4-pentenoic acid joined together by amide and ester bonds in a cyclic peptide lactone structure. AS

54

Mycotoxins in food.

Jarvis, B.

Scientific and Technical Surveys, British Food Manufacturing Industries Research Association No. 83, 20pp. (1974) [66 ref. En] Price £1.50 [British Food Manufacturing Ind. Res. Assoc., Randalls Rd., Leatherhead, Surrey, UK]

This survey forms the basis of a paper presented to the summer conference of the Society of Applied Bacteriology on 'Recent trends in food and agriculture' held at the Univ. of Aberdeen, Scotland in July 1974. The information is arranged under the following headings: Mycotoxins in stored agricultural products (cereals, nuts and oilseeds, and cheese) (pp. 4-8); Mycotoxins in mould-spoiled foods (pp. 8-9); Mycotoxins in animal products (pp. 9-12); Mycotoxins in mould-ripened foods (meat products and cheese) (pp. 12-14); Mycotoxins in fermentation products intended for food use (pp. 14-15); and Control of mycotoxins in foods (pp. 15-16). VJG

55

[Quantitative determination of sterigmatocystin with the aid of mass spectrometry.] Quantitative Bestimmung von Sterigmatocystin mit Hilfe der Massenspektrometrie. [Lecture]

Koller, W. D.; Orth, R.

Mitteilungsblatt der GDCh-Fachgruppe Lebensmittelchemie und Gerichtliche Chemie 29 (3/4) 153-157 (1975) [2 ref. De] [Inst. für Chemie und Tech., Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe, Federal Republic of Germany]

The basic suppositions of MS are listed and the theory and practice of measurements by MS discussed. Determination of sterigmatocystin involves the following steps: separation or purification by, e.g. TLC, quantitative elution with a solvent, transfer of an aliquot of the eluate to a special flask, evaporation of the solvent, linking the flask to the spectrometer via a direct inlet system, complete evaporation of the sample and recording

the peaks and shape of the curves obtained. Examples of a curve and a mass spectrogram are given for sterigmatocystin. [See also author index under **Germany, Federal Republic of, Gesellschaft Deutscher Chemiker [Symposium].**] JA

56

Aflatoxin and other mycotoxins.

Waart, J. de

Voedingsmiddelentechnologie 8 (11) 14-17 (1975) [13 ref. En] [CIVO-TNO, Zeist, Netherlands]

This paper includes data for the source, structure, occurrence, toxicity and physical properties of various mycotoxins presenting a significant health hazard, including aflatoxins, patulin, sterigmatocystin, ochratoxins, sporofusariogenin and stachybotryotoxin. AJDW

57

[The problem of mycotoxins in foods and beverages.] Das Mykotoxinproblem bei Lebensmitteln und Getränken. [Lecture]

Frank, H. K.

Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, IB 159 (4) 324-334 (1974) [23 ref. De, en]

[Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe, Federal Republic of Germany]

Mycotoxin formation by numerous kinds of microfungi is considered in this lecture; brief information on some 40 toxinogenic fungi, their mycotoxins and most important morbid effects is tabulated; and the public health importance of mycotoxins (attention being given to milk in infant nutrition), max. tolerances in foods and beverages, destruction or removal of mycotoxins, and preventive measures are discussed. SKK

58

[Symposium: mycotoxins.] Symposium: Mykotoxine. [Conference proceedings]

Frank, H. K. (**Germany, Federal Republic of, Bundesforschungsanstalt für Lebensmittelfrischhaltung**) (Editor)

Berichte der Bundesforschungsanstalt für Lebensmittelfrischhaltung No. 1, 54pp. (1973)

[De] [Bundesforschungsanstalt für Lebensmittelfrischhaltung, Engesserstrasse 20, D-7500 Karlsruhe, Federal Republic of Germany]

This report contains summaries of papers presented at the above symposium, organized by the Federal Research Centre for Food Preservation, held at Karlsruhe on 5 Oct. 1972. They include: Introduction to the problem of mycotoxins, by H. K. Frank (pp. 9-12, 11 ref.); Aflatoxins in foods and raw materials and in the manufacture of foods, by E. Hanssen & M. Jung (pp. 17-21, 22 ref.); Mycotoxins in milk and milk products, by F. Kiermeier (pp. 21-23, 11 ref.); Mycotoxins in meat and meat products, by L. Leistner & H.-J. Mintzlaff (pp. 24-27, 15 ref.); Aflatoxin effects in animals and man, by H. Bösenberg (pp. 28-31, 12 ref.); The influence of

mycotoxins on plants, by J. Reiss (pp. 32-36, 24 ref.); Biosynthesis of mycotoxins, by H. J. Rehm (pp. 36-38, 4 ref.); and Conditions of the formation of some carcinogenic mycotoxins, by R. Orth (pp. 39-45, 14 ref.). An appendix shows the structural formulae of 13 mycotoxins, and gives 15 further references. AL

59

[Moulds as indicators in product testing.]

Schimmelpilze als Indikatoren bei der Warenprüfung.

Stantschew, W. [Stanchev, V.]

Lebensmittel-Industrie 22 (3) 110 (1975) [De, en, ru] [D. Blagoev Coll., Varna, Bulgaria]

The use of the mould microflora (counts and species present) as an indicator of the quality of foods is discussed, with reference to: evaluation of the danger of spoilage; the mould microflora as an indicator of the storage and transport conditions to which the food has been subjected; detection of toxigenic moulds; prediction of shelf-life; determination of the optimal storage and transport conditions; and detection of changes in the product altering its uses. AJDW

60

[Mycotoxins in fatty products.] [Review]

Vitali, G.

Industria Alimentari 14 (2) 58-63 (1975) [18 ref. It, en] [Istituto Tec. Comm. 'A. Bordoni, Pavia, Italy]

This review deals with aflatoxins, ochratoxins and sterigmatocystins; presence of mycotoxins, aflatoxins in particular, in vegetable oils and milk and milk products; aflatoxicosis in man and animals; and mycotoxin determination. SKK

61

Microbiological assay of patulin, using *Bacillus megaterium*.

Stott, W. T.; Bullerman, L. B.

Journal of the Association of Official Analytical Chemists 58 (3) 497-499 (1975) [25 ref. En] [Dept. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, Nebraska 68503, USA]

B. megaterium NRRL 1368 was found to be sensitive to patulin and a suitable test organism for accurate, quantitative bioassay of the toxin. Optimum conditions for the test were determined. The response of the organism to patulin was found to be linear between 2 and 80 µg. When compared to TLC and spectrophotometric assay methods, the bioassay was found to be comparable in accuracy, but less sensitive. The test was found to be sensitive to 1.7 µg patulin. The assay is rapid (12-15 h), simple, and inexpensive and can be used to verify the toxicity of samples, as well as to quantitatively measure patulin in samples of liquid media, apple juice, and corn. AS

62

Tremorgenic mycotoxins from *Aspergillus caespitosus*.

Schroeder, H. W.; Cole, R. J.; Hein, H., Jr.; Kirksey, J. W.

Applied Microbiology 29 (6) 857-858 (1975) [3 ref. En] [ARS, Southern Region, College Station, Texas 77840, USA]

2 tremorgenic mycotoxins were isolated from *Aspergillus caespitosus*, and identified as verruculogen and fumitremorgin B. They were produced at the rate of 172 and 325 mg/kg, respectively, on autoclaved cracked field corn. AS

63

Stability of aflatoxin B₁ and ochratoxin A in brewing.

Chu, F. S.; Chang, C. C.; Ashoor, S. H.; Prentice, N.

Applied Microbiology 29 (3) 313-316 (1975) [16 ref. En] [Food Res. Inst., Univ. of Wisconsin, Madison, Wisconsin 53706, USA]

The stability of aflatoxin B₁ and ochratoxin A in brewing was investigated by adding the purified toxins to raw materials at 1 and 10 µg/g levels during mashing in a conventional micro-brewing process. The results indicate that both toxins are stable to heat and are insensitive to cooker mash treatment. Both mycotoxins were partially removed in mashing and brewing processes. About 14-18% and 27-28% of added toxins were found in final beers brewed from starting materials containing 1 and 10 µg, respectively, of either toxin/g. The possible route of transmission of mycotoxins into beer is discussed. AS

64

Mycotoxin-producing potential of mold flora of dried beans.

Mislivec, P. B.; Dieter, C. T.; Bruce, V. R.

Applied Microbiology 29 (4) 522-526 (1975) [24 ref. En] [Div. of Microbiol., FDA, Washington, DC 20204, USA]

To evaluate the potential for mycotoxin production by moulds in dried beans, the mould flora of 114 samples was determined both before and after surface disinfection of the beans with 5% NaOCl. Surface disinfection substantially reduced mould incidence, indicating that contamination was mainly on the surface. The flora, both before and after disinfection, was dominated by species of the *Aspergillus glaucus* group, the toxicogenic species *Asp. ochraceus*, *Penicillium cyclopium*, and *P. viridicatum*, and species of *Alternaria*, *Cladosporium*, and *Fusarium*. The toxicogenic species *Asp. flavus*, *Asp. versicolor*, *Penicillium citrinum*, *P. expansum*, *P. islandicum*, and *P. urticae* were encountered less frequently. Of 209 species of *Aspergillus* and *Penicillium* screened for mycotoxin production on sterile rice substrate, 114 produced ≥1 of the following mycotoxins: *Asp. flavus*, aflatoxins; *Asp. ochraceus*, ochratoxins; *Asp. nidulans*, *Asp. unguis*, and *Asp. versicolor*, sterigmatocystin; *P. cyclopium*, penicillic acid; *P. citrinum* and *P. viridicatum*, citrinin; *P. urticae*,

patulin and griseofulvin. Sterigmatocystin production by *Asp. unguis* is reported for the first time. AS

65

A convenient thin layer chromatographic cleanup procedure for screening several mycotoxins in oils.

Hagan, S. N.; Tietjen, W. H.

Journal of the Association of Official Analytical Chemists 58 (3) 620-621 (1975) [10 ref. En] [Rutgers Univ., Cook Coll., PO Box 231, New Brunswick, New Jersey 08903, USA]

A TLC cleanup development with benzene-hexane (LM+ 1) effectively removed lipids and some contaminants from mixtures of mycotoxins in corn oil, olive oil, peanut oil, soybean oil, and seed extracts. A second development in the same direction as the first, using toluene-ethyl acetate-formic acid (6 + 3 + 1) or benzene-acetic acid (9 + 1), separated the mycotoxins. Satisfactory separation was achieved for commercial oils spiked with sterigmatocystin, zearalenone, ochratoxins A, B, and C, and aflatoxins B₁, B₂, G₁, and G₂. This technique permits detection of 5 parts/billion aflatoxin B₁ in corn. AS

66

[Toxin production by *Fusarium* species and their occurrence in agricultural products.] Toxinbildung bei *Fusarium*-Arten und Vorkommen der Toxine in landwirtschaftlichen Produkten.

Lasztity, R.; Wöller, L.

Nahrung 19 (7) 537-546 (1975) [21 ref. De, en, ru] [Inst. für Biochemie und Lebensmittelchem., Tech. Univ., Budapest, Hungary]

Studies on the incidence of *Fusarium* spp. F-2 toxin (zearalenone) in several hundred samples of agricultural produce in Hungary showed that >200 samples of wheat, maize and fodder contained this toxin. TLC, GLC and IR spectrophotometric studies on extracts from *Fusarium* spp. are described. In addition to F-2, 2 other toxins (F-3 and F-4) were isolated. It is concluded from the IR spectra that the structure of F-3 and F-4 is similar to that of F-2. 6 of 10 *Fusarium* spp. studied were found to produce F-2 toxin. Growth and toxin production by *Fusarium* spp. were most active in samples stored at low temp. IN

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J. NEWTON
ASSISTANT EDITOR

VOLUME 6

I

Symposium on the control of mycotoxins.

International Union of Pure & Applied Chemistry
Sweden, Swedish National Committee for Chemistry

Pure and Applied Chemistry 35 (3) 209-313

(1973) [many ref. En]

This issue of the journal contains special lectures presented at the symposium on the Control of Mycotoxins, held in Göteborg, Sweden, in Aug. 1972 under the auspices of the International Union of Pure & Applied Chemistry, Food Contaminants Commission (Food Section), and the Swedish National Committee for Chemistry. The papers include: Study of toxins isolated from grain infected with *Fusarium sporotrichioides*, by M. A. Akhmeteli, A. B. Linnik, K. S. Cernov [Chernov], V. M. Voronin, A. Ja. Hesina [A. Ya. Khesina], N. A. Guseva & L. M. Sabad (pp. 209-215, 6 ref.); Review of the toxicology of aflatoxin, by W. H. Butler (pp. 217-222, 28 ref.); Learning to live with mycotoxins: aflatoxin - a case history, by L. A. Goldblatt (pp. 223-238, 28 ref.); Control of aflatoxins in the food industry, by E. Hanssen & M. Jung (pp. 239-250, 24 ref.); Recent research for the control of mycotoxins in cereal, by C. W. Hesselstine (pp. 251-257, 6 ref.); New methods for rapid detection of aflatoxin, by C. W. Hesselstine & O. Shotwell (pp. 259-266, 7 ref.); Collaborative studies on the determination of aflatoxins in peanut products in France, by M. Jemmali (pp. 267-270, 9 ref.). HBr

2

Symposium on the control of mycotoxins.

International Union of Pure & Applied Chemistry
Sweden, Swedish National Committee for Chemistry

Pure and Applied Chemistry 35 (3) 209-313

(1973) [many ref. En]

[Continued from preceding abstr.] Aflatoxin residues in fluid milk, by F. Kiermeier (pp. 272-273, 11 ref.); Aflatoxin residues in bacon pigs, by P. Krogh, B. Hald, E. Hasselager, A. Madsen, H. P. Mortensen, A. E. Larsen & A. D. Campbell (pp. 275-281, 11 ref.); The control of aflatoxin residues in food of animal origin, by I. F. H. Purchase (pp. 283-289, 35 ref.); Analysis of aflatoxin M₁ in liquid and powdered milk, by P. L. Schuller, C. A. H. Verhulsdonk & W. E. Paulsch (pp. 291-296, 22 ref.); Extraction and determination of *Aspergillus flavus* metabolites - aflatoxins from meat products, by E. L. Strzelecki (pp. 297-307, 17 ref.); and Chemical and biological detection of 12,13-epoxytrichothecenes isolated from *Fusarium* species, by T. Tatsuno, K. Ohtsubo & M. D. Saito (pp. 309-313, 22 ref.). HBr

3

[Purity of enzyme preparations. Mycotoxins.]

Fournier, P.-E.

Annales de Technologie Agricole 21 (4) 607-617

(1972) [23 ref. Fr, en, de] [Fac. de Med. de Univ., Paris VII^e, France]

Hazards arising during the manufacture of

enzymes on an industrial scale and from the addition of large doses of enzymes to foodstuffs are discussed. The possible contamination of enzymes with mycotoxins is considered. MEG

4

[Hygiene and toxicology of enzyme preparations.]

Beitrag zur hygienisch-toxikologischen Beurteilung der Enzymanwendung.

Engst, R.; Lewerenz, H.-J.

Annales de Technologie Agricole 21 (4) 619-627

(1972) [15 ref. De, fr, en] [Zentralinst. für Ernährung, Akad. der Wissenschaften, Potsdam-Rehbrücke, German Democratic Republic]

Problems of the occurrence of mycotoxins and other pathogenic or otherwise undesirable substances in enzyme preparations used in food production and the toxicological testing of such additives are discussed with reference to investigations and legislation in the German Democratic Republic. The problem of the adverse effect of enzyme addition on food products themselves is discussed briefly. MJD

5

[Symposium: mycotoxins.] Symposium: Mykotoxine

Frank, H. K. (Germany, Federal Republic of,

Bundesforschungsanstalt für

Lebensmittelfrischhaltung) (Editor)

54pp. (1973) [De] [Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe, Federal Republic of Germany]

Summaries of papers presented at this symposium, held at Karlsruhe in Oct. 1972, include: Introduction to the problems of mycotoxins, by H. K. Frank (pp. 9-12, 11 ref.); Mycotoxins in feedstuffs, by J. M. Möller (pp. 13-17, 13 ref.); Aflatoxins in foods and raw materials and in the manufacture of foods, by E. Hanssen & M. Jung (pp. 17-21, 22 ref.); Mycotoxins in milk and milk products, by F. Kiermeier (pp. 21-23, 11 ref.); and Mycotoxins in meat and meat products, by L. Leistner & H.-J. Mintzlaff (pp. 24-27, 15 ref.). CDP

6

Patulin production in apples decayed by *Penicillium expansum*.

Wilson, D. M.; Nuovo, G. J.

Applied Microbiology 26 (1) 124-125 (1973) [7

ref. En] [Dept. of Botany, Univ. of Vermont, Burlington, 05401, USA]

60 isolates of *Penicillium expansum* were tested for patulin production in decaying apples. All the isolates were found to produce the mycotoxin patulin as determined by TLC. Since patulin is known to be stable in many apple products, the results indicate that apple products made partially from apples decayed by *P. expansum* will contain patulin which may present a health hazard. The results also suggest that patulin may be important in the decay of apples by *P. expansum*. AS

7

Viriditoxin production by *Aspergillus viridi-nutans* and related species.

Lillehoj, E. B.; Milburn, M. S.

Applied Microbiology 26 (2) 202-205 (1973) [13 ref. En] [N. Regional Res. Lab., USDA, Peoria, Illinois 61604, USA]

Bioproduction of viriditoxin on various substrates by strains of the *Asp. fumigatus* group was determined under several incubation conditions. *Asp. viridi-nutans* strains NRRL 4365 and 576 produced the largest quantities of toxin, *Asp. brevipes* gave reduced yields, and there was no detectable synthesis by isolates of 4 related species. After 30 days in static culture at 20°C on various autoclaved agricultural commodities, optimal yields of 440 and 380 mg of toxin were observed/kg of sorghum and rice. Toxin levels were reduced on corn, rye and wheat (40-200 mg/kg); yields were low on cottonseed, barley and oats. Incubation at 10°C restricted biosynthesis of viriditoxin, and no toxin accumulated on substrates maintained at 5°C for 120 days. In a liquid, yeast extract-sucrose medium, max. mycotoxin production developed in shake flasks; after 156 h, 10 mg of toxin accumulated/g of mycelium. Viriditoxin produced in submerged culture was associated with the mycelium; <1% was detected in the filtered broth after 156 h of incubation. AS

8

Study of toxins isolated from grain infected with *Fusarium sporotrichioides*.

Akhmeteli, M. A.; Linnik, A. B.; Cernov[Chernov], K. S.; Voronin, V. M.; Hesina, A. J.[Khesina, A. Ya.]; Guseva, N. A.; Sabad, L. M.

Pure and Applied Chemistry 35 (3) 209-215 (1973) [6 ref. En] [Gamaleya Inst. of Epidemiology & Microbiol., Acad. of Med. Sci., Moscow, USSR]

Experiments with mice showed that an aqueous extract of barley grain which had been attacked by *Fusarium sporotrichioides* is blastogenic. There was a significant association between tumour-bearing and alphafoetoprotein when a sensitive immunoautoradiographic method was used. Chromatographic examination confirmed that the R_f value and the colour of fluorescence of extracts of grain infected with *Fusarium sporotrichioides* were substantially different from the aflatoxins used as controls or produced by *Aspergillus flavus*. AS

9

Chemical and biological detection of 12,13-epoxytrichothecenes isolated from *Fusarium* species.

Tatsuno, T.; Ohtsubo, K.; Saito, M.

Pure and Applied Chemistry 35 (3) 309-313 (1973) [22 ref. En] [Inst. of Physical & Chem. Res., Hiroshima, Wako-shi, Saitama-351, Japan]

A research team has isolated nivalenol, fusarenon-X, diacetylnivalenol, neosolaniol, 4-deoxynivalenol and 4-deoxy-3-acetylnivalenol from strains of *Fusarium* collected from rice, barley, cereals and pasture. The 12,13-epoxytrichothecenes, after trimethylsilylation of the trichothecene compounds, can be chemically detected to the order of 1 µg/ml using gas chromatography and mass spectroscopy. A biological assay method using HeLa cells, including morphological mode of cell damage and also

biochemical disturbances in not only protein synthesis but also DNA synthesis using radioactive precursors on the same cell culture system, is also presented. AS

10

Production of ochratoxins A and B on country cured ham.

Escher, F. E.; Koehler, P. E.; Ayres, J. C.

Applied Microbiology 26 (1) 27-30 (1973) [19 ref. En] [Dept. of Food Sci., Univ. of Georgia, Athens, 30602, USA]

2 strains of *Aspergillus ochraceus* and 6 of *Penicillium viridicatum* isolated from country cured hams were screened for production of ochratoxins A and B. None of the isolated *P. viridicatum* strains yielded detectable amounts of ochratoxin A or B, whereas both strains of *A. ochraceus* produced ochratoxins A and B on rice, defatted peanut meal, and country cured ham. After 21 days of incubation on ham, one-third of the toxin was found in the mycelial on the ham surface, whereas two-thirds had penetrated into the meat to a distance of 0.5 cm. AS

11

[Residues in meat: antibiotics and mycotoxins.]

Rückstände in Fleisch: Antibiotika und Mykotoxine. Schmidt, V.; Mintzlaff, H.-J.

Fleischwirtschaft 53 (9) 1211-1212 (1973) [De] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

Reduction of antibiotics residues in meat by restricting the feeding of nutritional doses to the first half of fattening period and feeding antibiotics-free fodder in the weeks preceding slaughter is recommended. Only antibiotics that do not induce transferable resistance should be used, e.g. flavomycin, Zn-bacitracin or nitrovin. Therapeutic administration should be legally controlled. While no mycotoxins could be detected in fermented sausages after ripening with some toxigenic strains and added penicillic acid was quickly inactivated, stored sausages contaminated with *Aspergillus versicolor* (a frequent contaminant, especially of meat products of low water activity) contained sterigmatocystin on skins and meat. Broiler feeding trials indicated the presence of aflatoxin residues in muscle and viscera after feeding a diet containing ≥5 ppm aflatoxin. RM

12

Mycotoxin-producing strains of *Penicillium viridicatum*: classification into subgroups.

Ciegler, A.; Fennell, D. I.; Sansing, G. A.; Detroy, R. W.; Bennett, G. A.

Applied Microbiology 26 (3) 271-278 (1973) [15 ref. En] [N. Regional Res. Lab., USDA, Peoria, Illinois 61604, USA]

13

12, 13-Epoxytrichothecenes: potential toxic contaminants of foods. [Review]

Wilson, B. J.

Nutrition Reviews 31 (6) 169-172 (1973) [19 ref. En] [Vanderbilt Univ. School of Med., Nashville,

Tennessee 37232, USA]

Structure, properties and the possible significance to human health of the trichothecenes, a group of highly toxic compounds, are discussed. A partial list of naturally-occurring trichothecenes and their fungal source is given. The LD₅₀ values for selected trichothecenes are tabulated. VJG

14

[Analytical problems in the detection of mycotoxins.] Analytische Probleme beim Nachweis von Mykotoxinen.

Bösenberg, H.

Bericht über die Getreidechemiker-Tagung 7 (146) 125-133 (1972) [11 ref. De] [Lehrstuhl für Mikrobiol., Tech. Univ., Hannover, Federal Republic of Germany]

See FSTA (1973) 5 8C228.

15

Collaborative study of the quantitative determination and chemical confirmation of sterigmatocystin in grains.

Stack, M. E.; Rodricks, J. V.

Journal of the Association of Official Analytical Chemists 56 (5) 1123-1125 (1973) [12 ref. En] [Div. of Chem. and Physics, FDA, Washington, DC 20204, USA]

A quantitative method of analysis for sterigmatocystin in grains was studied collaboratively by 17 participants. The results show that 7 analysts had difficulty with the corn and oat samples because of an oily residue in the sample extracts which interfered with sterigmatocystin on TLC plates. Barley and wheat samples were analysed without difficulty. All of the quantitative results show the type of random error expected for visual analyses of TLC plates. Confirmative tests for sterigmatocystin were carried out without difficulty. The methods for the quantitative determination of sterigmatocystin in barley and wheat and the chemical confirmation of sterigmatocystin have been adopted as official first action. AS

16

[Chemical analysis of mycotoxins. I. Gas chromatography of patulin and its derivatives and gas chromatographic analysis of patulin in rice.]

Suzuki, T.; Takeda, M.; Tanabe, H.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 12 (6) 489-494 (1971) [9 ref. Ja, en] [Nat. Inst. of Hygienic Sci., 18-1 Kamiyoga 1-chome, Setagaya-ku, Tokyo]

Gas chromatographic analysis was carried out using patulin and its derivatives, trimethylsilyl ether and acetate. Qualitative and quantitative measurements of patulin were possible with or without using the derivatives. Silyl ether of patulin gave the best response of the derivatives examined. Patulin contained in rice was satisfactorily extracted with ethyl acetate and water. Loss of patulin during clean-up by silica gel chromatography using n-hexane-methanol was negligible. TM

17

[Chemical analysis of mycotoxins. II. Gas chromatography of penicillic acid and its derivatives and gas chromatographic analysis of penicillic acid in rice.]

Suzuki, T.; Takeda, M.; Tanabe, H.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 12 (6) 495-500 (1971) [7 ref. Ja, en]

Penicillic acid (PA) itself was not sensitive on gas chromatography. Of several PA derivatives examined, the trimethylsilyl ether was most sensitive. The peak of the trimethylsilyl ether of PA on the gas chromatogram was so completely separated from that of patulin that simultaneous detection of both mycotoxins was possible. The trifluoroacetate of PA gave 2 peaks on the gas chromatogram which was considered to be possibly useful for the qualitative analysis of PA. Extraction of PA from rice, using a mixture of ethyl acetate and water (7:1), gave good results with a recovery of 97%. TM

18

Fungal toxins in foods. [Review]

Walbeek, W. van

Canadian Institute of Food Science and Technology Journal 6 (2) 96-105 (1973) [many ref. En] [Food Advisory Bureau, Health Protection Branch, Nat. Health & Welfare, Ottawa, Ontario]

The topic is reviewed under the following headings: aflatoxin (chemistry, toxicity, potential aflatoxin residues in food of animal origin, aflatoxin producing fungi, substrates supporting aflatoxin production, factors influencing toxin production, crops susceptible to fungal invasion prior to harvest, international control of aflatoxins, aflatoxins in hot humid regions and in temperate regions); ochratoxin A (chemistry, toxicity, production by *Aspergillus ochraceus* spp., source of ochratoxin producing aspergilli, natural occurrence of ochratoxin and citrinin, influence of low temp. on toxin production, occurrence of ochratoxin in peanuts, white beans and other foods); sterigmatocystin; and patulin. VJG

19

Inhibition of alcohol and lactic dehydrogenases by patulin and penicillic acid in vitro.

Ashoor, S. H.; Chu, F. S.

Food and Cosmetics Toxicology 11 (4) 617-624 (1973) [25 ref. En, fr, de] [Dept. of Food Sci., Univ. of Wisconsin, Madison, USA]

The inhibitory effect of patulin and penicillic acid, fungal toxins produced by several species of *Aspergillus* and *Penicillium*, on the 2 thiol enzymes alcohol dehydrogenase and lactic dehydrogenase was investigated. VJG

20

Effect of pH on the thermal destruction kinetics of patulin in aqueous solution.

Lovett, J.; Peeler, J. T.

Journal of Food Science 38 (6) 1094-1095 (1973) [20 ref. En] [USDHEW, Public Health Service,

FDA, Bureau of Foods, Div. of Microbiol., Cincinnati, Ohio 45226, USA]

Patulin in McIlvaine's buffers of pH 3.5, 4.5 and 5.5 was heated at 105, 110, 115, 120 and 125°C. Ethyl acetate extracts of heated solutions were assayed for patulin remaining by TLC. Thermal destruction parameters (D and z values) were estimated to determine the effect of pH on thermal destruction kinetics. The classical thermodynamic estimates (ΔH , ΔF , ΔS and E_{exp}) were also made from the data obtained. These data show patulin to be resistant to thermal destruction at all pH's from 3.5 to 5.5. Both D and z values increased, however, as the pH decreased. Destruction times at all temp. were greater for pH 3.5 than for 5.5, i.e. patulin is more stable in more acid solutions. IFT

21

Occurrence of patulin and patulin-producing strains of *Penicillium expansum* in natural rots of apple in Canada.

arwig, J.; Chen, Y.-K.; Kennedy, B. P. C.; Scott, P. M.

Canadian Institute of Food Science and Technology Journal 6 (1) 22-25 (1973) [26 ref. En, fr] [Health Protection Branch, Dept. of Nat. Health & Welfare, Tunney's Pasture, Ottawa, Ontario K1A 0L2]

In 28 of 61 naturally rotten apples examined, patulin, a toxic fungal metabolite, was detected in quantities of 0.02 to 17.7 mg per apple. *Penicillium expansum* (Link) Thom was isolated from 42 of the 61 apples. When grown in apples, 40 isolates produced patulin within 10 days of incubation at 25°C. All 42 isolates produced patulin in Raulin-Thom solution. Traces of citrinin were detected in some naturally rotten and inoculated apples. Larger amounts of citrinin were found in 7-day old cultures of 41 of the 42 isolates grown in Raulin-Thom solution. Where sorting of apples before processing is inadequate, patulin may be introduced into the final product. AS

22

The mycotoxin verruculogen: a 6-o-methylindole.

Cole, R. J.; Kirksey, J. W.

Journal of Agricultural and Food Chemistry 21 (5) 927-929 (1973) [8 ref. En] [Nat. Peanut Res. Lab., USDA, Dawson, Georgia 31742, USA]

Data are presented to support a 6-o-methylindole-type structure for verruculogen, a tremorgenic metabolite produced by *Penicillium verruculosum* isolated from mouldy peanuts. Conclusions are based on UV, NMR and MS analyses of verruculogen and 2 products from reductive cleavage of the tremorgen. AS

23

T-2 toxin as an emetic factor in moldy corn.

Ellison, R. A.; Kotsonis, F. N.

Applied Microbiology 26 (4) 540-543 (1973) [14 ref. En] [School of Pharmacy, Univ. of Wisconsin, Madison, 53711, USA]

Extracts of *Fusarium poae* NRRL 3287 grown either on sterile maize at 8°C or in Richards solution at room temp. were shown to have emetic activity in pigeons at nonlethal concn. under

conditions of oral and intravenous administration. The causative agent was found to be T-2 toxin (3-hydroxy-4,15-diacetoxy-8-[3-methylbutyryloxy]-12,13-epoxy- Δ^9 -trichothecene). Oral and intravenous mean toxic dose values for this compound were found to be 0.72 and 0.15 mg/kg, respectively, as compared with an oral mean lethal dose of 2.75 mg/kg. The fact that T-2 toxin causes emesis at nonlethal concn. may explain, at least in part, the observance of vomiting as a symptom resulting from ingestion of cereal grains infected with toxic *Fusarium* species containing T-2 or a similar toxin. AS

24

Aflatoxin and rubratoxin produced by *Aspergillus parasiticus* and *Penicillium rubrum* when grown independently, associatively, or with *Penicillium italicum* or *Lactobacillus plantarum*.

Aldermann, G. G.; Emeh, C. O.; Marth, E. H. *Zeitschrift für Lebensmittel-Untersuchung und -Forschung* 153 (5) 305-311 (1973) [22 ref. En, de] [Dept. of Food Sci., Univ. of Wisconsin, Madison, USA]

Asp. parasiticus (i) and *P. rubrum* (ii) were grown separately, associatively, or in combination with *P. italicum* (iii) and/or *L. plantarum* (iv). A glucose-salts broth and single strength and conc. grapefruit juice served as substrates. In broth incubated at 28°C for 7 days, production of aflatoxin by (i) was enhanced when the culture also contained (ii) + (iv), was unaffected by (iii), and was reduced by (ii), (ii) + (iii), or (iv). Production of aflatoxin in single strength grapefruit juice held at 28°C for 7 days was enhanced when (i) grew together with (ii) and (iv). Presence of all other cultures or combinations reduced aflatoxin production. Similar results were obtained with conc. grapefruit juice except that less aflatoxin was produced by all combinations of cultures. Rubratoxin production in broth was enhanced when (ii) grew in association with (i). All other combinations of cultures yielded less rubratoxin than did (ii) by itself. In single strength grapefruit juice, (i) caused a marked decline in rubratoxin production. Slight increase in yield of rubratoxin were obtained when cultures contained (iv) or (i) + (iv). Other combinations of cultures neither enhanced nor reduced rubratoxin production. All combinations of cultures enhanced rubratoxin production in conc. grapefruit juice with the highest yield appearing when (i) and (iv) grew together with (ii). Production of rubratoxin was similar in single strength and conc. grapefruit juice. AS

25

Environmental factors affecting the synthesis of toxins by species of *Fusaria*.

Sherwood, R.; Peberdy, J. F.

Progress Reports on Research and Development, Home-Grown Cereals Authority 1972/1973, 26-28 (1973) [En] [Dept. of Botany, Univ. of Nottingham, UK]

An outline is given of studies of effects on *Fusarium* growth and zearalenone (F_2) synthesis of

3 methods of storing damp grain (chilled grain storage, chemical preservation of grain, sealed storage). During chilled grain storage (5-10°C) *Fusarium* spp. can grow and be selectively propagated. The limits of grain moisture content and storage temp. required for fungal growth and F_2 synthesis were established from studies on maize, barley, wheat and oats. Max. toxin yield occurred at 12 and 18°C. Fungal invasion was influenced most by moisture content and F_2 synthesis by temp. A moisture content <18% is essential to prevent mycelial development. Once the fungus is established F_2 synthesis can occur at lower temp. Toxin-producing strains were inhibited by 2000 ppm propionic acid (increasingly being used for chemical preservation of grain, generally at levels ≥ 8000 ppm). Formic, acetic and butyric acids were inhibitory at 10 000 ppm but not at 1000 ppm. During storage in sealed silos (used for high moisture grain for animal feedstuffs) O_2 is replaced by CO_2 which inhibits growth of *Fusarium* spp. Slight air leakages could, however, lead to renewed microbial growth. JA

26

[Studies on the population of toxigenic fungi in foodstuffs. III. Microscopic study on fungus penetration into rice grains.]

Koh, C. M.; Choi, T. J.; Lew, J.

Korean Journal of Microbiology 10 (4) 191-194 (1972) [7 ref. Ko, en] [Dept. of Microbiol., Coll. of Med., Yonsei Univ., Seoul, S. Korea]

27

[Mycotoxins in foodstuffs. III. The production of patulin on different kinds of sliced bread by *Penicillium expansum*.] Mycotoxine in Nahrungsmitteln. III. Bildung von Patulin auf verschiedenen Schnittbrotarten durch *Penicillium expansum*.

Reiss, J.

Chemie Mikrobiologie Technologie der Lebensmittel 2 (6) 171-173 (1973) [25 ref. De, en, fr] [Mikrobiol. Lab., Grahamhaus Studt KG, Bad Kreuznach, Federal Republic of Germany]

Penicillium expansum (patulin-producing strain) grows on nutrient media (malt extract agar, Czapek-Dox agar and potato dextrose agar) and on different kinds of sliced bread when the acidity of the bread is approx. just under 9. Under these conditions *P. expansum* could be detected in whole meal bread (Graham), whole meal bread (Felke), wheat-germ bread and linseed bread after 10 days growth of the fungus, but not however after 20 days. It is suggested that SH-containing substances in the bread inactivate the mycotoxin after a prolonged incubation period. [See FSTA (1972) 4 7M830 for part II.] AS

28

[Mould and mycotoxin detection in meat products.] Schimmelpilzdiagnostik und Mykotoxinnachweis an Fleischprodukten.

Fiedler, H.

Archiv für Lebensmittelhygiene 24 (8) 180-184 (1973) [25 ref. De, en] [St.

Veterinäruntersuchungsamt, Krefeld, Federal Republic of Germany]

63 samples of meat products intentionally or unintentionally moulded consisting of 13 samples of mould-ripened salami, 16 or other raw sausage, 3 of braised sausage, 7 of cooked sausage, 9 of raw ham, 2 of ham fat, 5 of backfat, 1 of 'Bündner Fleisch' [raw ham dried in air], 2 of aspic and 5 of other meat products were examined for presence of moulds and mycotoxins. The 195 mould strains detected included 123 (63%) of penicillia and 47 (24%) of aspergilli. Within the penicillia, the most frequent spp. were: *P. cyclopium* (35%), *P. notatum* (26%), *P. expansum* (10%) and *P. chrysogenum* (7%). Within the aspergilli, the most frequent was *A. glaucus* (35%) among which *A. repens* accounted for 60%; *A. flavus* (13% of all aspergilli) consisted of 5 strain of *A. flavus* and 1 of *A. parasiticus*. No aflatoxins were detected in the 6 samples of meat products containing *A. flavus*; and no patulin, penicillic acid, ochratoxin A or citrinin were detected in the 53 remaining samples. It is concluded that presence of mycotoxins in market meat products is highly unlikely. SKK

29

Potential production of sterigmatocystin on country-cured ham.

Halls, N. A.; Ayres, J. C.

Applied Microbiology 26 (4) 636-637 (1973) [12 ref. En] [Dept. of Food Sci., Univ. of Georgia, Athens, 30602, USA]

In laboratory media, 10 of 16 isolates of *Aspergillus versicolor* from country-cured ham were capable of producing sterigmatocystin. 3 of these isolates were tested and found to produce sterigmatocystin on country-cured ham after 14 days of incubation at 20 or 28°C. AS

30

[Metabolites of some strains of *Penicillium* isolated from foods.]

Yamazaki, M.; Fujimoto, H.; Miyaki, K.

Journal of the Pharmaceutical Society of Japan [Yakugaku Zasshi] 92 (1) 101-104 (1972) [17 ref. Ja, en] [Inst. of Food Microbiol., Chiba Univ.]

The following toxic metabolites were produced in high yield when penicillia were cultured on rice: (+)-rugolisin from *Penicillium variabile*, viridicatin and viridicatol from *P. cyclopium*, and citreoviridin from *P. citreo-viride*. These fungi were isolated from some Japanese foods such as rice, miso and soy sauce. AS

31

Isolation of a new cardiotoxic protein from the edible mushroom, *Volvariella volvacea*.

Lin, J.-Y.; Jeng, T.-W.; Chen, C.-C.; Shi, G.-Y.; Tung, T.-C.

Nature, UK 246 (5434) 524-525 (1973) [8 ref. En] [Inst. of Biochem., Coll. of Med., Nat. Taiwan Univ.]

A toxic protein, volvatxin, was isolated from basidiocarps of *Volvariella volvacea* by homogenizing with acetic acid, mercaptoethanol and EDTA, precipitating with ammonium sulphate,

dialysing and applying the solution to a DEAE-Sephadex 50A column and eluting with acetic acid and mercaptoethanol. Only one major protein peak was obtained, named volvatoxin A. Toxicity was measured on mice, and LD-50 found to be 1.23 mg/kg body wt. The biological activity of volvatoxin is briefly discussed. Volvatoxin A was found to consist of volvatoxin A₁ (mol. wt. 50 000) and A₂ (24 000) by gel filtration. Both proteins had lost their original toxicity when tested separately. PG

32

Analysis and chemical confirmation of citrinin in barley.

Hald, B.; Krogh, P.

Journal of the Association of Official Analytical Chemists **56** (6) 1440-1443 (1973) [28 ref. En] [Inst. of Hygiene & Microbiol., Royal Vet. & Agric. Univ., DK-1870, Copenhagen V, Denmark]

A method is described for the quantitative estimation of citrinin in barley by extraction of acidified grain with chloroform. After filtration, the citrinin concn. is estimated visually or densitometrically, using quantitative TLC, by comparison with a citrinin standard. The method will precisely determine concn. of 0.5 ppm, with a lower limit of detection of about 0.2 ppm. A chemical confirmatory test involving formation of the acetate of citrinin is also described. AS

33

[Moulds on bread.] Die Schimmelpilze des Brotes. [Review]

Reiss, J.

Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, II **128** (7/8) 685-728 (1973) [87 ref. De, en] [Mikrobiol. Lab. der Grahamhaus Stadt KG, Bad Kreuznach, Federal Republic of Germany]

Important morphological and physiological properties of the following bread moulds are given: *Alternaria alternata*, *Aspergillus flavus*, *Asp. fumigatus*, *Asp. glaucus* group, *Asp. nidulans*, *Asp. niger*, *Asp. ochraceus*, *Cladosporium herbarum*, *Endomycopsis burtonii*, *Geotrichum candidum*, *Mucor mucedo*, *M. pusillus*, *M. spinosus*, *Neurospora sitophila*, *Penicillium crustosum*, *P. expansum*, *Rhizopus nigricans* and *Thamnidium elegans*. A key for the determination of the fungi as well as technical advice on the study of bread moulds and details of mycotoxin production are presented. AS

34

The bioassay of rubratoxins A and B using *Tetrahymena pyriformis* strain W.

Wyatt, T. D.; Townsend, R. J.

Journal of General Microbiology **80** (1) 85-92 (1974) [20 ref. En] [Dept. of Food Sci. & Applied Biol., Polytechnic of the S. Bank, Borough Road, London SE 1, UK]

35

[Toxic substances in barley infected with *Fusarium*

spp.]

Morooka, N.; Uratsuji, N.; Yoshizawa, T.; Yamamoto, H.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] **13** (5) 368-375 (1972) [9 ref. Ja, en] [Fac. of Agric., Kagawa Univ., Miki-cho, Kita-gun, Kagawa-ken]

Using the procedure employed for separation of fusarenone and nivalenol, toxic substances were separated from cereal grains infected with *Fusarium* in the Kagawa-ken area in 1970. Mouldy grains of barley and wheat mainly contained Rd toxin and nivalenol, the former was considered a new mycotoxin and had a scirpene nucleus. *Fusarium roseum* was found to be the causal fungus. IR and mass spectra of Rd toxin were investigated. TM

36

Environmental contaminants in foods - problems and possible solutions of the seventies.

Somers, E.

Australian Food Manufacture and Distributor **43** (2) 24, 26 28, 33 (1973) [13 ref. En] [Food Div., Food & Drug Directorate, Dept. of Nat. Health & Welfare, Ottawa, Canada]

Environmental contamination is discussed with reference to agricultural technology and the contamination of foodstuffs with pesticides, industrial pollution (heavy metals, Pb etc.) and naturally-occurring contaminants (fungal toxins). Possible solutions to the problem are outlined. VJG

37

A screening medium and method to detect several mycotoxins in mould cultures.

Bullerman, L. B.

Journal of Milk and Food Technology **37** (1) 1-3 (1974) [9 ref. En] [Dept. of Food Sci. and Tech., Univ. of Nebraska, Lincoln, 68503, USA]

A single culture medium consisting of rice powder (5%), corn steep liquor (4%), and agar (2%) was tested as a substrate for mycotoxin production using 34 known toxinogenic mould strains. Aflatoxins, ochratoxin A, sterigmatocystin, penicillic acid, patulin, citrinin, and zearalenone were each detectable in 4 days of incubation at 25°C using this medium. Extraction of melted agar cultures, in screw cap test tubes, with hot chloroform (55°C) followed by cooling to resolidify the agar greatly facilitated and simplified the extraction process and eliminated the need for separatory funnels. Mycotoxins were detected by treating developed TLC plates with ammonia fumes, p-anisaldehyde, and phenylhydrazine and then viewing the chromatoplates under UV and white lights. AS

38

Mycotoxin-producing potential of moulds isolated from flour and bread.

Bullerman, L. B.; Hartung, T. E.

Cereal Science Today **18** (10) 346-347 (1973) [14 ref. En] [Dept. of Food Sci. & Tech., Univ. of Nebraska, Lincoln, 68503, USA]

Fungal contamination of 3 brands of bleached

wheat flour and 3 brands of white and raisin breads stored for different lengths of time was investigated. Representative strains of *Aspergillus* and *Penicillium* were isolated from the flour and bread, and screened for their ability to produce mycotoxins (aflatoxins B₁ and G₁, sterigmatocystin, ochratoxin A, penicillic acid, patulin, citrinin and leuteoskyrin). Total mould counts of the flour samples examined ranged from 12 to 500 g. Moulds counts of the bread were very low. 70 moulds were isolated from flour and bread, 16 were classified as *Aspergillus* spp., 48 as *Penicillium* spp. and 6 as other genera. 9 strains of *Penicillium* isolated from flour produced penicillic acid, and 2 produced patulin. None of the *Aspergillus* spp. produced any of the toxins investigated. 4 *Penicillium* isolates from bread produced leuteoskyrin. 1 isolate of *Aspergillus* ochraceus from bread produced both ochratoxin A and penicillic acid. Flour contained more potentially toxic moulds than bread. VJG

39

Mycotoxins produced by fungi isolated from inshell pecans.

Schindler, A. F.; Abadie, A. N.; Gecan, J. S.; Mislivec, P. B.; Brickey, P. M.
Journal of Food Science **39** (1) 213-214 (1974)
[14 ref. En] [Div. of Microbiol., FDA, Washington, DC 20204, USA]

Pecans from various sources were examined. Potential mycotoxin producing moulds found were studied for toxin production by growing them on various substrates. Pecan were demonstrated to be suitable for the production of sterigmatocystin, aflatoxin and ochratoxin. The most prevalent mould species recovered, which are also known mycotoxin producers, were *Penicillium expansum* and *Aspergillus versicolor*. Also recovered were isolated of *Asp. ochraceus*, *Asp. parasiticus* and *Asp. sydowi*. Approx. 86% of the *Asp. versicolor* isolates tested produced sterigmatocystin. The single isolate of *Asp. parasiticus* produced aflatoxin. All other cultures tested failed to produce either patulin, ochratoxin or sterigmatocystin.

IFT

40

[Moulds and fungi as causes of spoilage in foods.]

Schimmelpilze und Hefen als Verderbniserreger von Lebensmitteln.

Knöpfel, H. P. (Switzerland, Schweizerische Gesellschaft für Lebensmittelhygiene)
Schweizer Brauerei-Rundschau **85** (1) 17-20 (1974) [De] [Versuchsst. Schweizerischer Brauereien, Zürich, Switzerland]

Abstracts are given of the following papers which were presented at the 6th working conference of the Schweizerische Gesellschaft für Lebensmittelhygiene, held on 2 Nov. 1973 in Rorschlikon, Switzerland: What are moulds and yeasts?, by E. Müller; Toxic metabolites from moulds, by H. K. Frank; Moulds and yeasts as causes of spoilage in beverages by H. U. Daepf; Pathogenic yeasts and moulds in foods and feeds, by H. Rieth; Moulds in cereals, by G. Spicher; and Detection of moulds and yeasts in food, by H. J.

41

[Toxic effects of various mycotoxins on silk worm (*Bombyx mori* L.) larvae in ad libitum feeding tests.]

Murakoshi, S.; Ohotomo, T.; Kurata, H.
Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] **14** (1) 65-68 (1973)
[8 ref. Ja, en] [Kanagawa Prefecture Inst. for Sericultural Sci., Nakashinden, Ebina-shi, Kanagawa-ken]

Toxic effects of 9 mycotoxins (including aflatoxins B₁ and G₁ and ochratoxin A) on silkworm larvae were determined in feeding trials. Results indicate that silkworm larvae would be useful agents for the bioassay of mycotoxins. TM

42

Mycotoxin formation affected by fumigation of wheat.

Vandegraft, E. E.; Shotwell, O. L.; Smith, M. L.; Hesseltine, C. W.

Cereal Science Today **18** (12) 412-414 (1973)
[10 ref. En] [N. Regional Res. Lab., Peoria, Illinois 61604, USA]

Samples of hard red winter wheat were fumigated with (i) methyl bromide (2 lb/1000 ft³, 24 h), (ii) 0,0-dimethyl 0-(2,2-dichlorovinyl) phosphate (20 ppm, 1 wk), (iii) ethylene dichloride: carbon tetrachloride (75:25 w/w) (3 gal/1000 bushels, 12 h) and (iv) chloropicrin (2 lb/1000 bushels, 48 h), aerated and stored in metal containers at 0°C for 2 wk before inoculation with *Aspergillus flavus* (4 strains), *Asp. parasiticus* (2 strains), *Asp. ochraceus* and *Penicillium viridicatum*. Half the fumigated and nonfumigated wheats were sterilized by autoclaving at about 25% moisture before inoculation. Of the 8 fungal strains used, 6 were affected by (i), 5 by (ii), 4 by (iii) and 1 by (iv). *Asp. parasiticus* and *Asp. flavus* strains produced aflatoxin and *Asp. ochraceus* and *P. viridicatum* produced ochratoxin. Yields of aflatoxin were higher on sterilized than unsterilized wheat. Ochratoxin production was little affected by sterilization. Fumigation both increased and decreased aflatoxin and ochratoxin production, depending on the fungal strain with which the wheat had been inoculated. VJG

43

[Harmful compounds in cereals - a problem of consumer protection.] Schadstoffe in Getreide - ein Problem des Verbraucherschutzes. [Lecture]

Seibel, W.; Ocker, H. D.

Mühle + Mischfüttertechnik **111** (11) 163-166 (1974) [11 ref. De] [Bundesforschungsanstalt für Getreideverarbeitung, Detmold, Federal Republic of Germany]

Max. permitted levels, origins, occurrence, effects of processing, and alternatives to using harmful compounds in cereals and cereal products are discussed. Harmful substances include radioactive compounds, heavy metals (e.g. As, Pb, Cd, Hg), carcinogenic hydrocarbons (e.g. benzpyrene), mycotoxins, and residues of pesticides and preservatives. While processing (hulling, milling) reduces levels in flour by 50-80%, it enriches

by-products which may be used in animal feed. Alternative methods are recommended which would reduce the level of contamination e.g. using non-persistent pesticides instead of persistent ones. RM

44

[Chemical and biological assay of fusarenone-X and diacetoxyscirpenol in cereal grains.]

Nakano, N.; Kunimoto, T.; Aibara, K.

Journal of the Food Hygienic Society of Japan

[Shokuhin Eiseigaku Zasshi] 14 (1) 56-64 (1973)

[7 ref. Ja, en] [Dept. of Biochem. Res. on Food,

Nat. Inst. of Health, Kamiosaki, Shinagawa-ku,

Tokyo]

In order to establish a method for detecting mycotoxins in grains, chemical and biological assays were carried out for fusarenone-X (Fu-X) and diacetoxyscirpenol (DAS) added to rice powder. Fu-X and DAS were extracted from the test material with n-hexane/methanol/NaCl and transferred into chloroform which was subjected to TLC, and its inhibitory activity on the growth of mouse leukaemia cells in vitro was established. The detection limits for Fu-X and DAS were 0.25 and 0.05 µg per spot by the chemical method and 0.04 and 0.003 µg per ml by the biological method, respectively. TM

45

[Present-day knowledge on milk hygiene with particular reference to the problem of residues.]

Milchhygiene aus heutiger Sicht unter besonderer Berücksichtigung des Rückstandsproblems.

[Review]

Kreuzer, W.

Wiener Tierärztliche Monatsschrift 61 (2) 57-66

(1974) [54 ref. De, en] [Bereich für Hygiene und

Tech. der Lebensmittel Tierischen Ursprungs,

Tierärztliche Fak., Univ., Munich, Federal

Republic of Germany]

Problems of milk hygiene, especially microbiological quality of milk and residues of various substances (antibiotics, disinfectants, mycotoxins, organochlorine pesticides, Pb, Cd, Hg, and radionuclides) in dairy products, are discussed in relation to animal health and milk handling and processing. It is pointed out that the present situation of residues in dairy products, although not constituting a hazard for healthy adults, has reached a critical stage as far as children and sick persons are concerned. ADL

46

Inhibition of muscle aldolase by penicillic acid and patulin in vitro.

Ashoor, S. H.; Chu, F. S.

Food and Cosmetics Toxicology 11 (6) 995-1000

(1973) [21 ref. En, fr, de] [Food Res. Inst., Univ. of Wisconsin, Madison, USA]

Penicillic acid and patulin are fungal toxins with an α-γ-unsaturated lactone structure produced by several spp. of *Aspergillus* and *Penicillium*. The inhibitory effect of these mycotoxins on aldolase as well as the interactions of these mycotoxins with the amino acid residues in the active sites of the

protein were investigated. Chemical analyses revealed that covalent interaction of each mycotoxin with the -NH₂ and -SH groups in aldolase occurred, causing inactivation of the enzyme. VJG

47

Deoxynivalenol and its monoacetate: new mycotoxins from *Fusarium roseum* and moldy barley.

Yoshizawa, T.; Morooka, N.

Agricultural and Biological Chemistry 37 (12)

2933-2934 (1973) [4 ref. En] [Dept. of Food

Sci., Fac. of Agric., Kagawa Univ., Japan]

48

Production of citrinin by *Penicillium viridicatum* on country-cured ham.

Wu, M. T.; Ayres, J. C.; Koehler, P. E.

Applied Microbiology 27 (2) 427-428 (1974) [14

ref. En] [Dept. of Food Sci., Univ. of Georgia,

Athens, 30602, USA]

7 strains of *Penicillium viridicatum* isolated from country-cured ham produced citrinin in potato dextrose broth and on country-cured ham. None of the strains produced detectable amounts of citrinin at 10°C. The optimal temp. range for citrinin production was 25 to 30°C. AS

49

Viriditoxin production by *Aspergillus viridi-nutans* and related species.

Lillehoj, E. B.; Milburn, M. S.

Abstracts of the Annual Meeting of the American

Society for Microbiology 73, 20 (1973) [En] [N.

Regional Res. Lab., Peoria, Illinois, USA]

Bioproduction of viriditoxin on various substrates by strains of the *Asp. fumigatus* group was determined under several incubation conditions. Quantitative TLC determinations of the mycotoxin were carried out on organic solvent extracts of the fermentations. *Asp. viridi-nutans* strains NRRL 4365 and 576 produced the largest quantities of toxin. *Asp. brevipes* gave reduced yields, and there was no detectable synthesis by isolates of 4 related species. After 20 days in static culture at 20°C on various autoclaved agricultural commodities, optimal yields of 0.4 and 0.3 mg of toxin were observed/g of sorghum and rice. Toxin levels were intermediate on corn, rye, and wheat; yields were low on cottonseed, barley, and oats. Incubation at 10°C reduced biosynthesis of viriditoxin, and no toxin accumulated on substrates inoculated with *Asp. viridi-nutans* and maintained at 5°C for 120 days. In a liquid, yeast extract-sucrose medium, max. mycotoxin production developed in shake flasks; after 132 h, 10 mg of toxin accumulated/g of mycelia (dry wt.). Viriditoxin produced in submerged culture was associated with the mycelium; <1% was detected in the filtered broth after 132 h of incubation. AS

50

Production of rubratoxin by *Penicillium rubrum* in soy whey fortified with malt extract.

Emeh, C. O.; Marth, E. H.

Abstracts of the Annual Meeting of the American Society for Microbiology 72, 28 (1972) [En]
[Univ. of Wisconsin, Madison, USA]

Sterile soy whey (1.75% dissolved solids) was fortified with 0.5, 1.0, 2.5, 5.0, and 10% malt extract and inoculated with spore suspensions of *P. rubrum* strains P-13, 1062, 2120, 2123, and 3290. Samples were incubated as stationary cultures at 28°C for 1, 3, 5, 7, 10, 12, 14, 17, 21, and 28 days and as shake cultures for 3, 7, and 14 days. After extraction, rubratoxins were resolved by repeated TLC and then were determined gravimetrically. Rubratoxin was not obtained in shake cultures. Toxin production in stationary cultures increased with an increase in malt extract concn. After max. production, toxin content of cultures levelled off and then decreased. The final pH varied from an initial value of 6.0 to a min. of 3.4 and a max. of 8.4. Rubratoxins A and B were recovered from whey cultures of all strains of *P. rubrum* except P-13 which produced only rubratoxin B. No toxin was recovered from samples with a final pH greater than 7.5. AS

51

Mycotoxin potential of mold flora from dried beans.
Mislivec, P. B.; Dieter, C. T.; Sanders, A. C.

Abstracts of the Annual Meeting of the American Society for Microbiology 73, 20 (1973) [En]
[FDA, Washington, DC, USA]

The mould flora of 75 samples of dried beans was determined. Samples, collected from warehouses, were plated on malt agar containing 7.5% NaCl, and incubated for 14 days at room temp. prior to mould speciation. The flora which dominated was *Aspergillus glaucus*, *Asp. ochraceus*, *Penicillium cyclopium*, *P. viridicatum*, plus species of *Cladosporium* and *Alternaria*. The toxic species, *Asp. versicolor*, *Asp. flavus*, *Penicillium citrinum*, and *P. urticae* occurred regularly, but in low %. When 100 isolates of toxic species were grown on sterile rice substrate at room temp., 7 different mycotoxins were produced: *Asp. flavus* - aflatoxins; *Asp. versicolor* - sterigmatocystin; *Asp. ochraceus* - ochratoxins; *P. urticae* - patulin and griseofulvin; *P. citrinum* - citrinin; *P. cyclopium* - penicillic acid; *P. viridicatum* - penicillic acid and citrinin. AS

52

Distribution of zearalenone-producing Fusarium species in Japan.

Ishii, K.; Sawano, M.; Ueno, Y.; Tsunoda, H.
Applied Microbiology 27 (4) 625-628 (1974) [20 ref. En] [Lab. of Microbial Chem., Fac. of Pharmaceutical Sci., Univ., Tokyo, Japan]

166 isolates of *Fusarium* spp. from domestic cereal grains, feed, and other sources were examined for their ability to produce zearalenone on autoclaved moist rice grains. They belonged to the following species (number of producers/number tested): *F. roseum* (9/28), *F. roseum* (*Culmorum*) (3/4), *F. roseum* (*Gibbosum*) (2/5), *F. roseum* (*Avenaceum*) (1/2), *F. roseum* (*Scirpi*)

(0/1), *F. tricinatum* (1/4), *F. tricinatum* (*Sporotrichiella*) (0/7), *F. lateritium* (1/1), *F. episphaeria* (0/2), *F. moniliforme* (0/3), *F. oxysporum* (0/12), *F. rigidiusculum* (0/4), *F. solani* (0/4), *F. splendens* (0/1), *F. nivale* (0/2), and *Fusarium* spp. (15/86). Zearalenone was isolated from moulded rice by ethanol extraction and purified by column chromatography. Selected isolates of *F. roseum* M-3-2 and *F. roseum* (*Gibbosum*) A-0-2 produced 50-100 mg zearalenone/kg rice. Increased yields (250 to 407 mg/kg of rice) were obtained by *F. roseum* M-3-2 when the substrate was supplemented with 1% peptone. AS

53

[Toxic materials in cereals - a consumer protection problem.] Schadstoffe im Getreide - ein Problem des Verbraucherschutzes.

Seibel, W.; Ocker, H. D.

Deutsche Müller-Zeitung 72 (9) 157-160 (1974) [11 ref. De] [Bundesforschungsanstalt für Getreideverarbeitung, Detmold, Federal Republic of Germany]

Contamination of cereals and cereal products (bread, flour and bakery products) with pesticides, fumigants, heavy metals, radioactive materials, carcinogenic hydrocarbons and mycotoxin is discussed, with reference to: legislation in the Federal Republic of Germany; sources and incidence of contamination; reduction of the concn. of contaminants during processing (aspiration, washing, husking and milling); problems of use of contaminant-enriched by-products, e.g. bran, in animal feeds; and prospects for reduction of the level of contamination of cereals. AJDW

54

Distribution of C¹⁴ in eggs from patulin-C¹⁴-fed hens.

Lovett, J.

Abstracts of the Annual Meeting of the American Society for Microbiology 72, 17 (1972) [En]
[FDA, Cincinnati, Ohio 45226, USA]

White Leghorn hens were housed in wire laying cages and fed a commercial laying mash. On the day the experiment began and each of the 3 following days, hens were given, via the crop, 50 mg uniformly labelled patulin-C¹⁴ in pH 5.0 McIlvaine's buffer. Eggs were collected for 16 days after the first treatment. In the laboratory, eggs were washed and dried, and albumen and yolk separated and weighed. Approx. 100 mg of each fraction were weighed into glass counting vials. NCS was used as the solubilizer and POP-POP-toluene as the scintillation fluid. After dark adaptation, vials were counted on a Packard 3375 to the 1% SD level. Whereas C¹⁴ activity was found in albumen within 24 h of patulin-C¹⁴ administration, activity in yolk was not detectable until the 5th day. Total activity/egg peaked on the 6th day and declined to near background by the 16th day. At peak C¹⁴ activity, patulin-C¹⁴ equivalent concn. was 261 µg/egg. No biological activity was associated with detected C¹⁴ activity.

The bio-assay system used was the paper disc procedure with an *Escherichia coli* strain. AS

55

Toxic molds in black and white peppercorns.

Mislivec, P. B.; Douglas, R. G.; Kautter, D. A. *Abstracts of the Annual Meeting of the American Society for Microbiology* 72, 27 (1972) [En] [FDA, Washington, DC, USA]

Mycotoxic moulds in 24 white and 108 black imported samples of peppercorns were determined. For each sample, 100 nondisinfected peppercorns and 100 peppercorns surface disinfected with 5% NaClO were plated on malt salt and potato dextrose agars. 73% of nondisinfected black peppercorns contained mould while only 12.3% of disinfected black peppercorns contained mould, indicating surface contamination. *Aspergillus glaucus* predominated both before and after disinfection. Other species occurring were: *Asp. flavus*, *Asp. niger*, *Asp. tamarii*, *Asp. sydowi*, *Asp. versicolor*, *Asp. ochraceus*, *Asp. fumigatus*. 100% of white peppercorns, both before and after disinfection, contained mould, indicating internal contamination. *Asp. niger*, *Asp. tamarii*, *Asp. versicolor* and *Penicillium islandicum* predominated before disinfection, while *Asp. versicolor*, *Asp. flavus*, *Asp. sydowi* and *P. citrinum* predominated after disinfection. *Asp. glaucus* was rare in white peppercorns. Isolates of the following produced mycotoxins on sterile rice: *Asp. flavus*, *Asp. ochraceus*, *Asp. versicolor* and *P. citrinum*. AS

56

Sensitivity of brine shrimp (*Artemia salina*) to trichothecenes.

Eppley, R. M. *Journal of the Association of Official Analytical Chemists* 57 (3) 618-620 (1974) [5 ref. En] [Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

Brine shrimp larvae have been successfully used as a biological monitoring system in the isolation of 5 naturally occurring, toxic 12,13-epoxy- Δ^9 -trichothecenes. A simplified procedure is described for the biological confirmation of these mycotoxins. The sensitivity of the brine shrimp test described for detecting 10 of the naturally occurring 12,13-epoxy- Δ^9 -trichothecenes is approx. 0.04-0.4 $\mu\text{g/ml}$. AS

57

Collaborative study of a chromatographic method for determination of patulin in apple juice.

Scott, P. M. *Journal of the Association of Official Analytical Chemists* 57 (3) 621-625 (1974) [6 ref. En] [Food Res. Lab., Health Protection Branch, Health & Welfare Canada, Ottawa, Ontario, K1A 0L2]

Collaborators in 20 laboratories studied a method for the determination of patulin in apple juice. The collaborators mixed patulin solutions with the apple juice to obtain 9 spiked samples (of which 2 were blanks) and 1 practice sample. After column chromatography of the apple juice extract, patulin was estimated visually by TLC, using 3-

methyl-2-benzothiazolinone hydrazone. HCl as the spray reagent. Mean recoveries of patulin ranged from 69.8 to 98.3% for 3 contamination levels. The method has been adopted as official first action for the determination of patulin in apple juice. AS

58

Patulin from *Penicillium expansum* in stone fruits and pears.

Buchanan, J. R.; Sommer, N. F.; Fortlage, F. J.; Maxie, E. C.; Mitchell, F. G.; Hsieh, D. P. H. *Journal of the American Society for Horticultural Science* 99 (3) 262-265 (1974) [19 ref. En] [Dept. of Pomology, Univ. of California, Davis, USA]

Concn. of patulin in blue mould lesions caused by *Penicillium expansum* Lf. ex Thom in pears and stone fruits were similar to those reported for apples. Of fruits tested, only the plum was a poor substrate for accumulation of the mycotoxin. The total patulin within disease lesions increased as the lesions enlarged. However, the concn. of patulin varied considerably, with the largest lesions usually yielding the lowest concn. Little or no patulin permeated healthy tissue surrounding the disease lesions unless fruits were overripe or had senescent breakdown. AS

59

Survey of corn for *Fusarium* toxins.

Eppley, R. M.; Stoloff, L.; Trucksess, M. W.; Chung, C. W. *Journal of the Association of Official Analytical Chemists* 57 (3) 632-635 (1974) [15 ref. En] [Div. of Chem. & Physics, FDA, Washington, DC 20204, USA]

Samples of the 1972 corn crop were collected in areas where the potential for *Fusarium* contamination of the corn was considered to be high or where known *Fusarium* damage had been reported. The 223 samples were collected in the spring following the crop yr from terminal elevators or from stocks on hand at food processing establishments and were analysed for zearalenone, aflatoxins, and T-2 toxin by a modified multimycotoxin detection method. A rabbit skin bioassay was used to screen for possible T-2 toxin at levels below the chemical detection limits. Zearalenone was found in 17% of the samples (0.1-5.0 mg/kg); aflatoxin was found in 5 samples (trace-10 $\mu\text{g/kg}$). A skin irritant was found in extracts from 93 of 173 samples by the rabbit skin bioassay. This effect may be due to the T-2 toxin or some other mycotoxin. AS

60

***Penicillium viridicatum* mycotoxicosis in the rat. I. Ocular lesions.**

McCracken, M. D.; Carlton, W. W. *Food and Cosmetics Toxicology* 12 (1) 79-88 (1974) [31 ref. En, fr, de] [Dept. of Vet. Microbiol. & Pathol., School of Vet. Sci. & Med., Purdue Univ., W. Lafayette, Indiana 47907, USA]

Penicillium viridicatum is a common contaminant of stored cereal grain and certain isolates have been

associated with intoxications in domestic animals. A description is given of ocular lesions and their development in rats fed a rice culture of an isolate of *P. viridicatum*, as well as in rats fed fungal mats. VJG

61

***Penicillium viridicatum* mycotoxicosis in the rat. II. Scrotal lesions.**

McCracken, M. D.; Carlton, W. W.; Tuite, J.
***Food and Cosmetics Toxicology* 12 (1) 89-98**
(1974) [18 ref. En]

See preceding abstr.

62

***Penicillium viridicatum* mycotoxicosis in the rat. III. Hepatic and gastric lesions.**

McCracken, M. D.; Carlton, W. W.; Tuite, J.
***Food and Cosmetics Toxicology* 12 (1) 99-105**
(1974) [21 ref. En, fr, de]

See preceding abstr.

63

[Mycotoxins, autochthonic agents inhibiting milk fermentation.]

Bacic, B.; Jovic, R.; Borota, M.; Milin, S.
***Mljekarstvo* 24 (1) 6-9 (1974) [6 ref. Sh]**
[Poljoprivredni Fak., Novi Sad, Yugoslavia]
Inhibition of *Lactobacillus bulgaricus*
fermentation of milk from individual producers is ascribed to presence in it of *Aspergillus fumigatus* mycotoxins derived from mouldy sugar beet pulp fed to cows. SKK

64

[Toxic metabolites of moulds.] Toxische Stoffwechselprodukte von Schimmelpilzen.

[Review]

Frank, H. K.

***Alimenta* 13 (3) 98-101 (1974) [31 ref. De]**
[Bundesforschungsanstalt für
Lebensmittelfrischhaltung, Engesserstrasse 20, D-
75 Karlsruhe, Federal Republic of Germany]

The most important mycotoxins in foods are reviewed, with special reference to carcinogenic mycotoxins, *Fusarium* toxins and cytochalasans. RM

65

[*Fusarium* toxins.] [Review]

Ueno, Y.

Journal of the Food Hygienic Society of Japan
[*Shokuhin Eiseigaku Zasshi*] 14 (5) 403-414
(1973) [86 ref. Ja] [Fac. of Pharmaceutical Sci.,
Sci. Univ., Ichigaya-Funagawara, Shinjuku-ku,
Tokyo, Japan]

This review discusses illnesses caused by toxins produced by *Fusarium* spp., chemical composition of the toxins, fungal spp. which produce the toxin trichothecene, conditions suitable for toxin production, and detection of toxic fungi and their toxins by chemical and biological methods. TM

66

Malting and brewing experiments with ochratoxin

and citrinin.

Gjertsen, P.; Myken, F.; Krogh, P.; Hald, B.
***Brygmesteren* 31 (7) 177-186 (1974) [12 ref. En,**

de, fr] [Res. Lab., Carlsberg Breweries, United Breweries, Copenhagen, Denmark]

See FSTA (1974) 6 5H702.

67

The effects of T-2 toxin in broiler chickens.

Wyatt, R. D.; Hamilton, P. B.; Burmeister, H. R.
***Poultry Science* 52 (5) 1853-1859 (1973) [27 ref. En]**
[Dept. of Poultry Sci., North Carolina St.
Univ., Raleigh, 27607, USA]

T-2 toxin is a very potent mycotoxin produced in feedstuffs by several species of the genus *Fusarium*. A study was made of T-2 toxicosis in chickens and findings compared with studies on the effects of aflatoxicosis. Several parameters related to tissue strength and integrity, which are severely altered during aflatoxicosis were measured. Analysis of variance revealed that capillary fragility, lateral shear strength of breast muscle segments, and acid phosphatase, which is a marker enzyme for lysozymes, were not changed significantly ($P < 0.05$) by T-2 toxin even at the highest dose level (16.0 µg/g). AA

68

Analysis of penicillic acid by gas-liquid chromatography.

Thorpe, C. W.; Johnson, R. L.

***Journal of the Association of Official Analytical Chemists* 57 (4) 861-865 (1974) [14 ref. En]**
[Div. of Chem. and Physics, FDA, Washington DC.
20204, USA]

A GLC method is described for the analysis of the mycotoxin penicillic acid in corn, dried beans, and apple juice. The samples are extracted with ethyl acetate and the penicillic acid is isolated by liquid/liquid extraction, followed by elution from a 3 g silica gel column with hexane/ethyl acetate. Penicillic acid is determined by GLC of the trifluoroacetate derivative, using a 6 ft column containing OV-101 and an electron capture detector. Penicillic acid can be detected at the 4 µg/kg level with recoveries of added penicillic acid >80%. Confirmation may be obtained by GLC/MS. Analysis of 20 commercial corn samples originating from several Midwest countries with potential mould problems showed that penicillic acid was present in 7 samples at levels ranging from 5 to 230 µg/kg. Penicillic acid was found in 5 of 20 commercial samples of dried beans at levels of from 11 to 179 µg/kg. AS

69

[Contamination of foods by fungi.]

Jemmali, M.

***Bulletin Technique d'Information* No. 287, 89-99**
(1974) [37 ref. Fr] [Service des Mycotoxines, 16,
Rue Nicolas-Fortin, 75013 Paris, France]

After a brief discussion of factors influencing growth of moulds on foods, problems of contamination of foods by mycotoxins are discussed with reference to a table summarizing the main toxigenic mould spp., the foods from which they

have been isolated, the mycotoxins formed, and the symptoms of poisoning by each mycotoxin.
AJDW

70

Simultaneous determination of patulin and penicillic acid in grains by gas chromatographic method.

Suzuki, T.; Fujimoto, Y.; Hoshino, Y.; Tanaka, A. *Agricultural and Biological Chemistry* **38** (6) 1259-1260 (1974) [3 ref. En] [Inst. of Public Health in Saitama, Kamiokubo, Urawa, Japan]

The method described for determination of patulin and penicillic acid as their trimethylsilyl derivatives uses GLC with flame ionization detection. Extraction and clean-up procedures for application of the method to grains are detailed. Recoveries of patulin and penicillic acid added to rough and polished rice, barley, flour and soybean at the 1 ppm ranged from 72.9 (soybean) to 79.5% (polished rice) for patulin, and from 74.6 (flour) to 87.6% (polished rice) for penicillic acid. The limit of detection was about 0.2 ppm. The 2 toxins were also determined in samples of mouldy rice; amounts found were 3.6 ppm patulin and 8.0 ppm penicillic acid. JA

71

Study of the occurrence of ochratoxin A in green coffee beans.

Levi, C. P.; Trenk, H. L.; Mohr, H. K. *Journal of the Association of Official Analytical Chemists* **57** (4) 866-870 (1974) [14 ref. En] [Tech. Center, General Foods Corp., White Plains, New York 10625, USA]

Mouldy green coffee beans were found to contain *Aspergillus ochraceus* and detectable levels of ochratoxin A. The official first action method for the detection of ochratoxins in barley, 26.C15-26.C22, was modified for analysis of coffee beans and a number of survey samples of coffee beans were analysed. *Asp. ochraceus* was found to be present in almost all samples but ochratoxin A was infrequently observed. Ochratoxin A production in sterile green coffee beans inoculated with *Asp. ochraceus* under optimal conditions was max. at 13 days at room temp. but the total amount was low (450 µg/kg). Considerable destruction (approx. 80%) of ochratoxin A occurred during a heat treatment which simulated the roasting of coffee beans. AS

72

Fate on ochratoxin A and citrinin during malting and brewing experiments.

Krogh, P.; Hald, B.; Gjertsen, P.; Myken, F. *Applied Microbiology* **28** (1) 31-34 (1974) [14 ref. En] [Inst. of Hygiene & Microbiol., Royal Vet. & Agric. Univ., Copenhagen, Denmark]

The fate of ochratoxin A and citrinin during malting and brewing processes was studied by the use of naturally contaminated lots of barley, as well as by the addition of crystalline toxins to the mash. Complete degradation was observed for ochratoxin A from moderately contaminated barley lots and for citrinin added to mash. The use of highly

contaminated barley resulted in transmission of ochratoxin A into the beer, but only 2-7% of the initial content was detected, corresponding to levels of 6-20 µg of ochratoxin A/l. of beer. Barley lots with this high ochratoxin contamination (1000-5000 µg/kg) will be easily detected and, therefore, because of pronounced deterioration, should be rejected during inspection upon admittance to breweries. AS

73

Production of 3-(1,2-epoxypropyl)-5,6-dihydro-5-hydroxy-6-methylpyran-2-one by *Aspergillus ochraceus* Wilhelm.

Moore, J. H.; Murray, T. P.; Marks, M. E. *Journal of Agricultural and Food Chemistry* **22** (4) 697-698 (1974) [15 ref. En] [Dept. of Biol., Univ. of N. Alabama, Florence, 35630, USA]

The metabolite 3-(1,2-epoxypropyl)-5,6-dihydro-5-hydroxy-6-methylpyran-2-one has been isolated from the culture medium of an ochratoxin-producing isolate of *Asp. ochraceus*. This metabolite was also produced in trace amounts on corn and rye. AS

74

Toxicity of fatty acids in assays for mycotoxins using the brine shrimp (*Artemia salina*).

Curtis, R. F.; Coxon, D. T.; Levett, G. *Food and Cosmetics Toxicology* **12** (2) 233-235 (1974) [9 ref. En] [Chem. Div., Agric. Res. Council, Food Res. Inst., Colney Lane, Norwich NOR 70F, UK]

An investigation of the potential mycotoxins produced by *Aspergillus sydowi* involved an established technique based on the toxicity of mycotoxin towards larvae of the brine shrimp. Fractionation of toxic extracts from the fungus showed that a major part of the observed toxicity resided in the fatty acid fraction, of which linoleic acid was a major component. Further investigations showed that some common naturally occurring fatty acids possess toxicity towards the brine shrimps comparable with that of several known mycotoxins. AS

75

New obligations imposed by current regulatory replications.

Hanold, T. *Food Product Development* **7** (9) 30, 32, 34 (1973) [En] [Pillsbury Co., Minneapolis, Minnesota, USA]

Implications are considered, of current regulations in the following fields: food ingredients (additives, mycotoxins); consumer protection and processing; food labels; and food advertising. Present and future regulations in these fields are listed. VJG

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VOLUMES 1-5

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J. NEWTON
ASSISTANT EDITOR

VOLUME 1

1

A method for the determination of sterigmatocystin in grain and oilseeds.

Vorster, L. J.; Purchase, I. F. H.

Analyst 93 (1111) 694-96 (1968) [6 ref. En] [Nat. Nutr. Res. Inst., Council for Sci. & Ind. Res., Pretoria, S. Africa]

Sterigmatocystin, a mycotoxin which is carcinogenic, has gained increasing significance as a food and feed contaminant. Details of a sensitive procedure for its quantitative determination are given. The method involves successive extractions by a number of solvents followed by thin-layer chromatography. The lower limit of visual detectability for sterigmatocystin can be decreased to 0.0025 μg by conversion of the mycotoxin to the monoacetate which fluoresces an intense blue on thin-layer chromatographs when viewed under UV light. JA

2

Mycotoxins. [A review]

Wogan, G. N.; Mateles, R. I.

Progress in Industrial Microbiology 7: 149-75 (1968) [135 ref. En] [Dept. Nutrition and Food Sci., Inst. Technology, Cambridge, Mass. 02139, USA]

The problem of mycotoxins as food contaminants is reviewed. EAW

3

[Mycotoxins in cereals and cereal products.]

Mykotoxine in Getreide und Getreideprodukten. Spicher, G.

Brot und Gebäck 22 (12) 237-41 (1968) [39 ref. De]

The formation of mycotoxins by parasitic fungi and storage fungi is discussed and mycotoxins formed by *Aspergillus* and *Penicillium* spp. are listed. The occurrence and effects of *A. flavus* toxins are discussed in detail. Some moulds present in the air of bakeries can produce toxins when grown on bread. It appears that some *Conidia* can also survive baking temp. and the fungal mycelium grows from inside the bread towards the crust. IN

4

A method for the analysis of cereals and groundnuts for three mycotoxins.

Vorster, L. J.

Analyst 94 (1115) 136-42 (1969) [14 ref. En] [Nat. Nutrition Res. Inst. of the South African Council for Sci. and Industrial Res., P.O. Box 395, Pretoria, R. of South Africa]

A method for the quantitative determination of aflatoxin (i), ochratoxin (ii), and sterigmatocystin (iii) in 1 extract of maize, sorghum or groundnuts is described. The method involves separation of the mycotoxins by column chromatography on silica gel, followed by thin layer chromatography and matching of the fluorescence intensity of sample spots with that of spots from standard solutions of (i), (ii) or (iii). For samples with high fat content

the method is modified by a NaHCO_3 extraction of the mycotoxins from the sample extract. Dark coloured pigments are removed from the sample extract by treatment with Hyflo Supercel. The method is fast and gives results accurate to $\pm 20\%$ at concn. of 10-500 $\mu\text{g}/\text{kg}$ (i), 50-2000 $\mu\text{g}/\text{kg}$ (ii) and 200-2000 $\mu\text{g}/\text{kg}$ (iii). IN

5

The effect of some mycotoxins on the brine shrimp, *Artemia salina*.

Brown, R. F.

Journal of the American Oil Chemists' Society 46 (2) 119 (1969) [3 ref. En] [Division of Microbiology, Food and Drug Administration, Dept. of Health, Education and Welfare, Washington, D.C. 20204, USA]

The use of the brine shrimp, *Artemia salina*, for the bio-assay of mycotoxins is suggested. Aflatoxin B_1 at concn. of 1.0 and 0.5 $\mu\text{g}/\text{ml}$ produced 90 and 61% mortality after 24 h at 37.5°C. Partially purified ochratoxin A at levels of 1.0, 2.0 and 16.0 $\mu\text{g}/\text{ml}$ produced 15, 23 and 49% mortality. The test requires only 0.5 ml of artificial sea water, which can maintain up to 50 brine shrimp larvae. [See also FSTA (1969) 1 1R13.] MEG

6

Note on the natural occurrence of ochratoxin A. Shotwell, O. L.; Hesseltine, C. W.; Goulden, M. L. **Journal of the Association of Official Analytical Chemists** 52 (1) 81-83 (1969) [9 ref. En] [Northern Regional Res. Lab., Peoria, Illinois 61604, USA]

164 samples of corn were examined for the presence of ochratoxins. 1 sample contained ochratoxin A with perhaps a trace of ochratoxin C but no B. The amount of A present was 110-150 parts/billion. MEG

7

Ochratoxin A: occurrence as natural contaminant of a corn sample.Shotwell, O. L.; Hesseltine, C. W.; Goulden, M. L. **Applied Microbiology** 17 (5) 765-66 (1969) [6 ref. En] [Northern Regional Res. Lab., Agric. Res. Service, USDA, Peoria, Illinois 61604, USA]

Ochratoxin A, a mould metabolite of the same order of toxicity as aflatoxin B has been isolated by growing strains of *Aspergillus ochraceus* Wilh. on various cereal products. This paper gives details of a method of analysis developed for ochratoxin, which was applied in a survey of corn from commercial markets. Ochratoxin was isolated from 3 out of 164 corn samples, believed to be the first record of its detection as a natural contaminant. The positive corn was low grade material of high moisture content, high % damage, and musty odour. ELC

8

Protecting our foods from environmental intrusion. [A symposium]

United States of America, Institute of Food

Technologists

Food Technology (Champaign) 23 (4) 528-30 & 532; 23 (6) 778, 780, 782 & 784-85 (1969) [51 ref. En]

Papers presented at this symposium which was held during the 28th Annual Meeting of the Inst. of Food Technologists in Philadelphia, USA, were: 'Microbial and chemical hazards in food', by W. W. Payne & P. Kotin; 'Bacterial toxins in food', by M. S. Bergdoll; 'Mycotoxins and other plant poisons', by B. J. Wilson. Topics considered include the cumulative nature of hazards from foods and other substances, and the principles and considerations which led to the establishment of the Nat. Inst. of Environmental Health Sciences. Botulism, *Clostridium perfringens* food poisoning, *Staphylococcus* food poisoning, and toxic metabolites of fungi, algae and higher plants are also discussed. JA

VOLUME 2

9

Detection of toxicity of aflatoxins, sterigmatocystin, and other fungal toxins by lethal action on zebra fish larvae.

Abedi, Z. H.; Scott, P. M.

Journal of the Association of Official Analytical Chemists 52 (5) 963-69 (1969) [49 ref. En] [Res. Lab., Food and Drug Directorate, Dept. of Nat. Health and Welfare, Ottawa, Ontario, Canada]

The effects of 13 fungal toxins (and one derivative) on the larvae of zebra fish, *Brachydanio rerio* (Hamilton-Buchanan), were investigated. The most toxic were sterigmatocystin, gliotoxin, and aflatoxin B₁, which were lethal at concn. of <1 µg/ml. Aflatoxins B₂, G₁, and G₂, stemphone, diacetoxyscirpenol, ochratoxin A, aspertoxin, and patulin also showed toxicity to the larvae, while aflatoxin B₁ hemiacetal, penicillic acid, and griseofulvin were non-toxic at the levels tested. Specific morphological effects were noted with sterigmatocystin, aflatoxins, and stemphone. The usefulness of zebra fish larvae as bioassay test organisms for fungal toxins is discussed. [See also *FSTA* (1969) 1 1C4.] AS

10

Isolation and purification of ochratoxins A and B and preparation of their methyl and ethyl esters. Nesheim, S.

Journal of the Association of Official Analytical Chemists 52 (5) 975-79 (1969) [10 ref. En] [Division of Food Chem. and Technology, Food and Drug Administration, Washington, DC 20204, USA]

Ochratoxins are extracted with hot chloroform from *Aspergillus ochraceus* cultures grown on moist shredded wheat breakfast cereal. The chloroform solution is mixed with hexane to precipitate the ochratoxins, which are filtered off and redissolved in fresh chloroform. The ochratoxins are further purified by extraction from the chloroform solution with 0.5M aqueous bicarbonate and transfer to another portion of chloroform after acidification of the salt solution. Ochratoxins A and B are separated from each other by gradient silica gel column chromatography, using an acetic acid-benzene

eluant; the fractions are analysed by thin layer chromatographic densitometry. Final purification is by crystallization of ochratoxin A from benzene and ochratoxin B from methanol. The ethyl and methyl esters of ochratoxins A and B are prepared by boron fluoride-catalysed esterification with ethanol or methanol and are purified by aqueous NaHCO₃ extraction from a chloroform solution. AS

11

Toxins from mouldy cereals. [A review]

Bamburg, J. R.; Strong, F. M.; Smalley, E. B.

Journal of Agricultural and Food Chemistry 17 (3) 443-50 (1969) [81 ref. En] [Dept. of Biochem., Univ., Madison, Wisconsin 53706, USA]

The emphasis of this review is placed on foods and feeds and the chemical nature and biological effects of mycotoxins that may be contained therein. A table gives the structure and toxicity of mycotoxins from fungi associated with cereal grains. Diseases discussed in detail are alimentary toxic aleukia, yellow rice toxicosis, vulvo-vaginitis in swine, epidemic polyuria, fungal nephrotoxicity in swine and mouldy corn toxicosis. JA

12

Natural food poisons.

Campbell, A. D.

Food Technology in Australia 21 (9) 460-61 & 463 (1969) [En]

This article describes mainly the work of the US Food and Drug Administration in developing analytical methods for the detection of aflatoxins and other mycotoxins in foodstuffs. MEG

13

Mycotoxins of the trichothecane family produced by *Fusarium tricinatum* and *Trichoderma lignorum*.

Bamburg, J. R.; Strong, F. M.

Phytochemistry 8 (12) 2405-10 (1969) [10 ref. En] [Dept. of Biochem., Univ., Madison, Wisconsin 53766, USA]

Mycotoxins of toxigenic strains from mouldy cereals were isolated by extraction and chromatography and identified by UV, infrared, and nuclear magnetic resonant spectroscopy. In addition to diacetoxyscirpenol (4,15-diacetoxy-12,13-epoxy-⁹-trichothecen-3-ol) and T-2 toxin (4,15-diacetoxy-8-(3-methylbutyryloxy)-12,13-epoxy-⁹-trichothecen-3-ol), *F. tricinatum* when grown at 24°C produced a new trichothecane derivative, HT-2 toxin, which was isolated and identified as 3,4-dihydroxy-15-acetoxy-8-(3-methylbutyryloxy)-12,13-epoxy-⁹-trichothecene, i.e. desacetoxy T-2. *T. lignorum* was also found to produce T-2 toxin, in addition to the previously reported trichodermin (4-acetoxy-12,13-epoxy-⁹-trichothecene). This is the first time that fungi of different genera have been shown to produce T-2 toxin. RM

14

The analysis of foods for aflatoxins and other fungal toxins. A review. [A review]

Scott, P. M.

Canadian Institute of Food Technology Journal 2 (4) 173-77 (1969) [98 ref. En] [Food & Drug Directorate, Ottawa, Ontario, Canada]

15

The separation and detection of several mycotoxins by thin-layer chromatography.

Steyn, P. S.

Journal of Chromatography 45 (3/4) 473-75 (1969) [17 ref. En] [Nat. Chemical Res. Lab., CSIR, Pretoria, R. of S. Africa]

A method for the simultaneous separation and detection of aspertoxin, ochratoxins A and B, secalonin acid D, 8 α -(3-methylbutylryloxy)-4 β , 15-diacetoxyscirp-9-en-3 α -ol, aflatoxins B₁ and G₁, 6-hydroxyrosenonolactone, cyclopiazonic acid, zearalenone and sterigmatocystin, using plates of Silica Gel G impregnated with oxalic acid. The developing solvent was chloroform:methylisobutylketone (4:1). The mycotoxins are detected by exposure to UV light or by spraying with conc. H₂SO₄ and heating at 110°C for 10 min or with 1% ethanolic FeCl₃. MEG

16

[Poisoning from moulds in foods.] Gifte von Schimmelpilzen in Lebensmitteln.

Frank, H. K.

Verbraucherdienst B 14 (4) 73-75 (1969) [De] [Inst. für Physik und Biologie, Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe, W. Germany]

To prevent mycotoxin poisoning from moulds which develop on foods, a control system is being set up in W. Germany, to implement the sensitive and rapid analytical methods available. It is pointed out that aflatoxins have not been isolated from even heavily mould-contaminated home-made jams, and that aflatoxin-forming strains could not be cultivated on these jams. IN

17

review]

Mycotoxins: methods for detection in foods. [A review]

Ayres, J. C.; Lillard, H. S.; Lillard, D. A.

Food Technology 24 (2) 161-64 & 166 (1970)

[Numerous ref. En] [Univ., Athens, Georgia 30601, USA]

The applicability and value of screening, presumptive and confirmatory tests in analysis of foods for the presence of mycotoxins (with

emphasis on aflatoxins) are reviewed. Use of both physicochemical tests and bioassays remains necessary to prove contamination. IFT

18

Mycotoxins in ruminants.

Lancaster, M. C.

Proceedings of the Nutrition Society 28 (2) 203-12 (1969) [48 ref. En] [Nuffield Unit for Lab. Animal Pathology, Univ., Edinburgh, Scotland]

Diseases caused by ergot toxins from *Claviceps purpurea*, sporidesmin from *Pithomyces chartarum* and aflatoxin from *Aspergillus flavus*, their history and identification, are briefly reviewed

and their biological effects in ruminants are considered. No residues have been detected in carcasses or milk of cattle fed ergot or sheep fed sporidesmin. The occurrence of residues of aflatoxin in carcasses and of its metabolite aflatoxin M₁ in milk of cows and sheep given large doses of aflatoxin B, is discussed with particular reference to public health. CDA

19

[The mycotoxins.] [A review]

Hesseltine, C.-W.

Industries d'Alimentation Animale 1969 (208) 25, 27, 29-31, 33, 35, 37, 39, 41, 43 (1969) [33 ref. Fr]

[Northern Regional Res. Lab., Peoria, Illinois, USA]

The main characteristics of mycotoxins (substrates, optimum formation conditions, effects, chemical composition) are discussed and tabulated. Biological effects of aflatoxins are discussed on the basis of literature data. IF

20

[Influence of sorbic acid on mycotoxinogenic fungi in food.] Der Einfluss der Sorbinsäure auf mycotoxinbildende Pilze in Lebensmitteln.

Wallhäuser, K. H.; Lück, E.

Deutsche Lebensmittel-Rundschau 66 (3) 88-92 (1970) [7 ref. De, en, fr] F[arbeitswerke Hoechst AG, Frankfurt(Main)-Höchst, W. Germany]

Food toxins, mycotoxins in particular, are briefly considered and methods of aflatoxin determination discussed. Expt. are described in which 2 *Aspergillus flavus* strains (producing respectively aflatoxins (i) B₁ + B₂ and (ii) B + K + M), (iii) *Asp. ochraceus*, (iv) *Penicillium citreoviride*, (v) *Byssoschlamys fulva*, (vi) *Sporodesmium bakeri* and (vii) *Fusarium sporotrichoides* were tested for resistance in foods to sorbic acid. 0.0625 or 0.125% sorbic acid (as potassium sorbate) were added to orange drink inoculated with 10, 100 or 1000 (i) or (ii) spores/ml; no growth was observed in any of the samples after storage for 9 and 21 days in the light at 22°C. The rind of semi-hard cheese was painted with a 20% aqueous solution of potassium sorbate, and allowed to dry; the cheese was then cut into pieces each with 10 cm² rind, which were inoculated with spores of (i)-(iv) or (vii). After 2 months' storage at 27°C and 95% RH only pieces with (i) or (ii) showed some sparse and retarded growth. Samples of commercial tomato pulp inoculated with (i)-(vii) remained free from growth for 2 months in the presence of 0.1 or 0.2% potassium sorbate. Panned wheat bread (surface area, 2000 cm²) baked from flour to which 0.5% sorboyl palmitate had been added and packaged in plastics bags contaminated on the inside with 1 ml suspension of 1000 (i) or (ii) spores/ml remained free from growth for $\geq$ 14 days. All controls without sorbic acid became heavily contaminated. SKK

21

Production of ochratoxin A in cereal products by *Aspergillus ochraceus* NRRL 3174.

Fun Sun Chu; Butz, M. E.

Bacteriological Proceedings 1970: 3 (1970) [En] [Univ., Madison, Wisconsin, USA]

The production of ochratoxin A in wheat bran (WB), polished rice (PR), chopped corn (CC), and bleached wheat flour (FW) at 4, 20, 28, and 37°C was studied. Ochratoxin A was extracted from the cereal product with chloroform-methanol (1:1) after incubation for various times. The extracted solution was conc., treated with base and acid, and reextracted with chloroform. The partially purified toxin was then chromatographed on a silica gel G-HR thin-layer plate. Quantitative analysis of the toxin was performed by using a spectrophotofluorodensitometric method. The result indicated that the optimal temp. and time for ochratoxin A production were 28°C and 7-9 days for CC, 9-11 days for PR, 11-14 days for WB and WF. ~1.50-1.77 mg of ochratoxin A/g of CC, PR, and WB was produced at the optimal temp. and time. Flour appeared to be a poor medium; only 0.53 mg of toxin/g of the substrate was produced. AS

22

Mycotoxin from the blue eye mould of corn.

Kurtzman, C. P.; Ciegler, A.

Bacteriological Proceedings 1970: 8 (1970) [En]
[Northern Regional Res. Lab., Peoria, Illinois, USA]

Blue eye is a common storage disease of corn caused by several species of *Penicillium*. One of these species, *P. martensii*, is prevalent on corn from central Illinois. This mould grows well on high-moisture corn at near freezing temp. This fact becomes significant where in commercial practices, high-moisture corn is stored under refrigeration. In expt., mice died in 2-3 days after ingesting corn moulded by *P. martensii* and from intraperitoneal injections of chloroform extracts of this corn. The toxic substance was extracted and crystallized, and was found to be penicillic acid. A quantitative chemical assay procedure was developed which is applicable for detection of penicillic acid in corn and other grains. Penicillic acid production occurred over a temp. range of 1-34°C. Greatest production occurred at the lower temp. where up to 5.85 mg/g of corn was produced. AS

23

The extraction, purification, detection, quantitative measurements and confirmation of ochratoxin A, B and C of *Aspergillus ochraceus* Willh.

Domiciano Broce, H.

Dissertation Abstracts International. Section B. The Sciences and Engineering 30 (7) 3059-60(1970) [En] [St. Univ., Baton Rouge, Louisiana, USA]

New methods for the purification, detection, quantitative measurement and confirmation of ochratoxins in foodstuffs were investigated. A rapid sensitive thin layer chromatographic (TLC) technique on dip-coated microscopic slides was modified for qualitative screening of mycotoxins (sensitivity 0.01 µg). A new clean-up procedure which included Florsil column chromatography achieved recoveries of 95, 98 and 90% for ochratoxins A, B and C respectively. Quantitative determination (based on the solid state fluorescence emission of the toxins) was measured directly on TLC plates with a fluorodensitometer,

coeff. of variation being 9.6, 10 and 5.7% for ochratoxins A, B and C respectively. UV spectrophotometry was used qualitatively and quantitatively. A trifluoroacetic anhydride-tetrahydrofuran (TFA-THF) derivatographic method could be used as a routine method of direct TLC confirmation of presumptive ochratoxins A and B extracts, and results further substantiated by UV spectroscopy and microbiological assay of these derivatives using *Bacillus cereus mycoides* LSU as the test organism. The latter could provide routine overnight results, with a sensitivity of 1.5 and 3 µg for ochratoxins A and B respectively. AL

24

Ochratoxins A and B confirmation by microbiological assay using *Bacillus cereus mycoides*.

Broce, D.; Grodner, R. M.; Killebrew, R. L.; Bonner, F. L.

Journal of the Association of Official Analytical Chemists 53 (3) 616-19 (1970) [7 ref. En] [St. Univ., Baton Rouge, Louisiana 70803, USA]

25

Mycotoxins. [A review]

Moss, M. O.

International Biodeterioration Bulletin 5 (4) 141-50 (1969) [80 ref. En] [Dept. of Biological Sci., Univ. Surrey, 14 Falcon Rd., London SW11, England]

26

Production of rubratoxin B by *Penicillium purpurogenum* stoll.

Natori, S.; Sakaki, S.; Kurata, H.; Udagawa, S.; Ichino, M.; Saito, M.; Umeda, M.; Ohtsubo, K. **Applied Microbiology 19 (4) 613-17 (1970) [17 ref. En]** [Nat. Inst. of Hygienic Sci., Kamiyoga-1-chome, Setagaya-ku, Tokyo, Japan]

Culture filtrates and chloroform extracts of *P. purpurogenum* isolated from foodstuffs had a lethal effect both on HeLa cells and on mice, in which necroses of the liver, kidney and small intestine and mitotic disorders, similar to those seen in HeLa cells, were observed. The effects of the culture filtrates were similar to those of isolated rubratoxin B. Isolated crystals of ether extract of the filtrate were identified as rubratoxin B by comparison of their physical properties with those of rubratoxin B. GECV

27

[Mycotoxins in foods. III. Formation of ochratoxin in various foods.] Mykotoxine in Lebensmitteln. III. Mitt.: Bildung von Ochratoxinen in verschiedenen Lebensmitteln. Rehms, H.-J.; Schmidt, I. **Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, II. Abteilung 124 (3/4) 364-68 (1970) [14 ref. De, en]** [Inst. für Lebensmittelchemie, Technische Hochschule, Munich, W. Germany]

Aspergillus ochraceus was inoculated into various foods and drinks (nuts, fats, wheat, rye, oats (meal or flakes), apple and grape juice). Growth of the organism was accompanied by

production of varying amounts of ochratoxins, A, B and C. Flaked oats contained the highest concn. of ochratoxin A (700 µg/g), far above the LD₅₀ for ducklings which is ~25 µg. BR

VOLUME 3

28

Aflatoxin. Scientific background, control, and implications. [A book]

Goldblatt, L. A. (Editor)

xii+472pp. (1969) [Numerous ref. En] New York, USA & London, UK: Academic Press Inc. Price \$21.50 [Southern Utilization Res. and Development Div., Agric. Res. Service, USDA, New Orleans, Louisiana, USA]

This volume in the Food Science and Technology series of Monographs is of interest to all concerned with production and processing of food and feeds, nutrition and animal and public health. Chapters include: Aflatoxin formation by *Aspergillus flavus*, by U. L. Diener & N. D. Davis (pp. 13-54, numerous ref.); Structure and chemistry of aflatoxins, by G. Buchi & I. D. Rae (pp. 55-75, 29 ref.); Physicochemical assay of aflatoxins, by W. A. Pons, Jr. & L. A. Goldblatt (pp. 77-105, 80 ref.); Biological assay for aflatoxins, by M. S. Legator (pp. 107-49, 74 ref.); Metabolism and biochemical effects of aflatoxins, by G. N. Wogan (pp. 151-86, 66 ref.); Types of mycotoxins in foods and feeds, by A. J. Feuill (pp. 187-221, numerous ref.); Aflatoxicosis in farm animals, by R. Allcroft (pp. 237-64, 67 ref.); Aflatoxicosis and trout hepatoma, by J. E. Halver (pp. 265-306, 57 ref.); Fungal spoilage in stored crops and its control, by C. Golu (numerous ref.); Processing to ensure wholesome products, by C. J. Kensler & D. J. Natoli (pp. 333-35, 17 ref.); Appendix (Voluntary code of food practices for purchasing, handling, storage, processing and testing of peanuts. 6th edition, Nat. Peanut Council, Aug. 1968) (pp. 355-58); Detoxification of aflatoxins in foods and feeds, by F. G. Dollear (pp. 359-91, 78 ref.); Regulatory aspects of control of mycotoxins in foods and feeds, by B. L. Osér (pp. 395-400, 6 ref.); and Implications of fungal toxicity to human health, by H. F. Kraybill & R. E. Shapiro (pp. 401-41, numerous ref.). JA

29

[Toxin-forming fungi.] Toxinbildende Schimmelpilze.

Frank, H. K.

Confructa 15 (2) 68-71 (1970) [22 ref. De, en]

[Inst. für Physik und Biol., Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe, W. Germany]

A review is given of toxin-forming fungi and mycotoxins, with special emphasis on patulin (synonyms: clavatin, claviformin, expansin, leucopin, mycoin C, penicidin, ternicin), a 4-hydroxy furopyran with strong phytotoxic and zootoxic properties. Its occasional presence in fruit products cannot be ignored. Tolerance levels for aflatoxins in fodder in Common Market countries are given. JMS

30

Fluorodensitometric assay of penicillic acid. Ciegler, A.; Kurtzman, C. P.

Journal of Chromatography 51 (3) 511-16 (1970) [10 ref. En] [Northern Regional Res. Lab., Peoria, Illinois 61604, USA]

A fluorodensitometric method was developed for the quantitative analysis of penicillic acid, a toxic secondary mould metabolite. The method depends on the conversion by ammonia fumes of penicillic acid after thin-layer chromatography to a fluorescent derivative. This technique was used successfully to analyse mouldy corn and a liquid fermentation for this toxin. AS

31

Stability studies with patulin.

Pohland, A. E.; Allen, R.

Journal of the Association of Official Analytical Chemists 53 (4) 688-91 (1970) [23 ref. En]

[Div. of Food Chem. and Tech., FDA, Washington, DC 20204, USA]

The chemical stability of patulin in a variety of foods and feeds, in various solvents and in the presence of SO₂ in water was investigated spectrophotometrically. Patulin was found to be completely stable in apple juice and dry corn; however, in wet corn, Durham wheat, and sorghum and in the presence of SO₂ in water, patulin was observed to be unstable. Patulin was completely stable over long periods of time in chloroform, benzene, and methylene chloride, but slow decomposition was noted in methanol and water. AS

32

Some food facts and fallacies.

Coppock, J. B. M.

Community Health 1 (5) 237-44 (1970) [En]

[Spillers Ltd., Old Change House, Cannon St., London, EC4, UK]

Toxicants occurring naturally in commonly used foods, such as pressor amines in bananas and cheese; goitrogens in cabbage, cauliflower, sprouts and turnips; fungal toxins on cereals; haemagglutinins in legumes; myristicin in nutmeg; solanine in potatoes oxalates in rhubarb, turnips, are discussed. PEG

33

[Trends in mycotoxin research in the past and present.] Tendenzen der Mycotoxin-Forschung in Vergangenheit und Gegenwart. [A lecture]

Meyer, H.; Leistner, L.

Archiv für Lebensmittelhygiene 21 (8/9) 178-84 (1970) [Numerous ref. De, en] [Inst. für Bakt. und Hist., Bundesanstalt für Fleischforschung, Kulmbach, W. Germany]

Development of mycotoxin research up to the present day is discussed. While research into ergotism was carried out before 1890 it was almost non-existent by 1960, when research into toxic antibiotics and mould products was at its height. Aflatoxin research started about 1960 and today is pursued to almost the same extent as that into moulds and antibiotics. Mycotoxin research, other than aflatoxins, was prominent in the 1920's and today is again so. A table of toxic moulds is given as well as one of mycotoxins grouped according to their degree of toxicity, and a table giving the year of discovery of important mycotoxins from 1900 to 1970. At the present time ~60 mycotoxins and 240 toxigenic mould species are known. OA

34

Zearalenone production by *Fusarium* species [on autoclaved corn].
Caldwell, R. W.; Tuite, J.; Stob, M.; Baldwin, R.
Applied Microbiology 20 (1) 31-34 (1970) [20 ref. En] [Dept. of Botany and Plant Pathology, Purdue Univ., Lafayette, Indiana 47907, USA]

35

Analysis and chemical confirmation of patulin in grains.

Pohland, A. E.; Allen, R.
Journal of the Association of Official Analytical Chemists 53 (4) 686-87 (1970) [7 ref. En]
[Division of Food Chem. and Technology, Food and Drug Administration, Washington DC 20204, USA]

A method is described for the quantitative estimation of patulin in corn, wheat, rye, oats, and sorghum. The procedure involves extraction of the grain with acetonitrile-hexane (4:1) followed by further clean up through preparative thin-layer chromatography (TLC). The patulin concn. is estimated using quantitative TLC on Mallinckrodt 7GF fluorescent plates by comparison with a pure patulin standard. The lower limit of detection in corn by this method is $\sim 40 \mu\text{g/kg}$. A chemical confirmatory test involving formation of the phenylhydrazone derivative is described. AS

36

Biological assays for two mycotoxins produced by *Fusarium tricinctum*.

Burmeister, H. R.; Hessektine, C. W.
Applied Microbiology 20 (3) 437-40 (1970) [9 ref. En] [N. Regional Res. Lab., USDA, Peoria, Illinois 61604, USA]

37

SOS/70. 3rd International Congress of Food Science and Technology, Washington, DC, Aug. 9-14, 1970. Abstracts of papers. Food safety. [A symposium]
Ingram, M. (United States of America Institute of Food Technologists) (Chairman)
Abstracts 90, 91, 92, 93, 94, 95 & 96 (1970) [En]
[Meat Res. Inst., Bristol, UK]

Abstracts are presented of the following papers:
Incidence of *Salmonella* with special reference to northwestern Europe, by E. H. Kampelmacher; An evaluation of salmonellosis in the United States, by K. H. Lewis; *Vibrio parahaemolyticus* poisoning in Japan, by T. Kawabata; Viral hepatitis associated with foods, by D. O. Cliver; Importance of aflatoxin in foods with reference to India, by H. A. B. Parpia & V. Sreenivasa Murthy; Determination of aflatoxins in foods and feeds, by W. A. Pons Jr., A. F. Cucullu & L. S. Lee; and Mycotoxins other than aflatoxins, by G. N. Wogan. JA

38

Determination of patulin in apple juice.

Pohland, A. E.; Sanders, K.; Thorpe, C. W.
Journal of the Association of Official Analytical Chemists 53 (4) 692-95 (1970) [19 ref. En]
[Div. of Food Chem. and Tech., FDA, Washington, DC 20204, USA]

A method is described for the quantitative analysis of patulin in apple juice involving ethyl acetate extraction followed by derivatization of the patulin and subsequent GLC analysis of the

derivative. Preparation of 3 derivatives, the silyl ether, acetate, and chloroacetate, is described. Using the acetate derivative and the hydrogen flame detector, recoveries of patulin in spiked apple juice are 90% or better and the detection limit is $\sim 0.7 \mu\text{g/ml}$. AS

39

[Fungi in fruit juices and dangers from products of their metabolism.] Pilze in Fruchtsäften und die Gefährlichkeit ihrer Stoffwechselprodukte. [A lecture]
Rehm, H.-J.

Flüssiges Obst 37 (8) 342-46 (1970) [20 ref. De]
[Inst. für Mikrobiol. Univ., Münster, W. Germany]

The most important fungi occurring in fruit juices *Byssoschlamys fulva*, *Penicillium velutinum*, *P. roqueforti*, *P. expansum*, *P. digitatum*, *Aspergillus niger*, *Asp. amstelodami*, *Cladosporium sirais*, their spoilage capacity and mycotoxin production are discussed. Topics covered are: primary and secondary products of fungal metabolism and their importance in fruit juice spoilage; mechanism of formation, and factors influencing the formation of mycotoxins (aflatoxins, byssochlamic acid, ochratoxin A, luteoskyrin, patulin); and possibilities of mycotoxin formation under various technological conditions (pasteurized or unpasteurized juice, low or high O_2 content in juice, effect of raw materials spoiled by fungi, storage in contaminated tanks). Structural formulae of the mycotoxins are given. JMS

40

Production of ochratoxin A by *Aspergillus ochraceus* isolated in Japan from mouldy rice.
Yamazaki, M.; Maebayashi, Y.; Miyaki, K.
Applied Microbiology 20 (3) 452-54 (1970) [8 ref. En] [Inst. of Food Microbiol., Univ., Narashino, Chiba, Japan]

A simple TLC-fluorodensitometric method for quantitative analysis of ochratoxin A was developed. This method proved to be of use in investigating the production of the toxin and the nutritional factors affecting toxin production by 2 strains of *Asp. ochraceus* isolated from mouldy rice in Japan. These fungi produced large amounts of ochratoxin A in a nutrient solution containing 1% L-phenylalanine and 2% yeast extract. AS

41

[The importance of fungi in food.] Die Bedeutung von Schimmelpilzen bei Lebensmitteln.
Frank, H. K.

Ernährungs-Umschau 17 (9) Lehre u. Praxis: 33-34 (1970) [De] [Bundesforschungsanstalt für Lebensmittelfrischhaltung, Karlsruhe, W. Germany]

The following topics are briefly discussed: fungi as source of aroma and flavour compounds in food e.g. Gorgonzola cheese; production of antibiotics by fungi; toxic fungi, covering ergot and aflatoxins; and carcinogenic mycotoxins. MJS

42

Mycotoxins, a menace of moulds.

Spensley, P. C.
Royal Society of Health Journal 90 (5) 248-54 (1970) [28 ref. En] [Tropical Products Inst., 56-

62 Grays Inn Road, London WC1, UK]

After surveying briefly the literature on various mycotoxins, the author presents a more detailed review of aflatoxin, with special reference to its discovery, toxicology, biochemistry, analysis, microbiology (production), occurrence, control, and implications for man. EJM

43

Detection of mycotoxins by thin-layer chromatography: application to screening of fungal extracts.

Scott, P. M.; Lawrence, J. W.; Walbeek, W. van *Applied Microbiology* 20 (5) 839-42 (1970) [18 ref. En] [Res. Lab., Food and Drug Directorate, Dept. of Nat. Health and Welfare Tunney's Pasture, Ottawa, Ontario, Canada]

A convenient TLC screening procedure for the detection of 18 mycotoxins is described. AS

44

[Mycotoxins in foods. IV. Effect of byssochlamic acid, aflatoxin B₁ and luteoskyrin on some enzymes.] Mykotoxine in Lebensmitteln. IV. Wirkung von Byssochlaminsäure, Aflatoxin B₁ und Luteoskyrin auf einige Enzyme.

Schmidt, I.; Rehm, H.-J. *Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, II. Abteilung* 125 (5) 520-24 (1970) [16 ref. De, en] [Inst. für Lebensmittelchem., Tech. Hochschule, Munich, W. Germany]

The mycotoxins byssochlamic acid, aflatoxin B₁, and luteoskyrin were tested as to their effect on the activity of 6 enzymes. At a concn. of 10⁻² M byssochlamic acid inhibited adenosine-deaminase completely, while at a concn. of 10⁻³ M it showed only a weak effect. Alcohol-dehydrogenase and isocitrate-dehydrogenase were inhibited by byssochlamic acid at a concn. of 10⁻² M. Aflatoxin B₁ and luteoskyrin did not show any effect on the activity of the enzymes tested. A combination of byssochlamic acid and aflatoxin B₁ had no greater influence on alcohol-dehydrogenase, isocitrate-dehydrogenase and adenosine-deaminase. [See FSTA (1969) 1 5C183, (1970) 2 8C19C & 12C272 for parts I, II & III.] AS

45

[The occurrence of mycotoxins or other active factors in products prepared from contaminated tomatoes.]

Halacka, K.; Polster, M.; Pribela, A. *Vitalstoffe - Zivilisationskrankheiten* 15 (3) 92-94 (1970) [5 ref. Fr, de, en] [Inst. of Hygiene, Fac. of Med., Trida Obrancu Miru 10, Brno, Czechoslovakia]

The toxicity of tomato pulp made from fruits contaminated with moulds, chiefly *Aspergillus flavus*, *Penicillium expansum*, *Fusarium sporotrichiella*, *Cladosporium herbarum* and also other moulds, e.g. *Phytophthora infestans* was investigated. The affected pulp was distinguished by its dark colour and bitter flavour. Preparative chromatography produced 1 bitter and 3 fluorescent fractions (blue-violet, blue, blue-green) whose absorption spectra and R_f values differed from aflatoxins. Biological tests with white mice and 2-day old ducklings produced liver lesions (lobular centres of inflammation and

necroses) which differed from the effects of aflatoxins. Blue fluorescent fraction exhibited strongest toxicity which increased with dose. Toxic effects were produced by quantities corresponding to normal consumption. RM

46

Spectrophotofluorodensitometric measurement of ochratoxin A in cereal products.

Chu, F. S.; Butz, M. E. *Journal of the Association of Official Analytical Chemists* 53 (6) 1253-57 (1970) [20 ref. En] [Food Res. Inst., Dept. of Food Sci., Univ., Madison, Wisconsin 53706, USA]

A spectrophotofluorodensitometric method for measurement of ochratoxin A on TLC plates has been described. The lower limit concn. of this method is 0.5-1.0 ng ochratoxin A/spot. A method including extraction and primary treatment for detection of ochratoxin A in cereal products has also been developed. The adequacy of this method is evident from the different recovery experiments. >85% of the added toxin was recovered in most analyses. The overall precision of the measurement was 3-4%. The sensitivity of this method was ~10-50 µg/Kg. AS

47

Survey of corn for aflatoxin, zearalenone and ochratoxin.

Shotwell, O. L.; Hesseltine, C. W.; Goulden, M. L.; Vandegraft, E. E. *Cereal Chemistry* 47 (6) 700-07 (1970) [12 ref. En] [N. Regional Res. Lab., Peoria, Illinois 61604, USA]

A total of 283 corn samples from commercial markets, including samples from all grades, from the crop year 1967, were assayed for the presence of aflatoxin, ochratoxin, and zearalenone. Samples were extracted and assayed by the procedure developed by the FDA for multitoxin analysis. The sensitivity limits of the analysis as carried out were 1-3 parts per billion (ppb) aflatoxin B-1 and G-1, 50 ppb ochratoxin A, and 200 ppb zearalenone. 6 of the samples (5 in sample grade (SG) and 1 in grade 3) contained aflatoxin in low levels. One SG corn contained ochratoxin A. Zearalenone was identified in 2 SG samples, and F-3, an oestrogenic factor related to zearalenone, could also be present. AS

48

[Veterinary aspects of chemical contamination of foods of animal origin.] [A review]

Tiecco, G.; Valfre, F. *Atti della Società Italiana delle Scienze Veterinarie* 24: 55-176 (1970) [652 ref. It] [Istituto Superiore di Sanita, Rome, Italy]

The review covers antibiotics, pesticides, mycotoxins, oestrogens and antithyroid agents. IMD

49

A multimycotoxin detection method for aflatoxins, ochratoxins, zearalenone, sterigmatocystin, and patulin.

Stoloff, L.; Nesheim, S.; Yin, L.; Rodricks, J. V.; Stack, M.; Campbell, A. D. *Journal of the Association of Official Analytical Chemists* 54 (1) 91-97 (1971) [19 ref. En] [Div. of

Food Chem. and Tech., FDA, Washington, DC 20204, USA]

In response to the need for a more comprehensive and simple procedure for multiple mycotoxin detection than had heretofore been devised, a method has been developed for detection of aflatoxins B₁, B₂, G₁ and G₂, ochratoxins A and B and their ethyl esters, zearalenone, sterigmatocystin, and patulin. The method is based on selective extraction with acetonitrile-water, defatting with isooctane, and removal of water-soluble components by transfer of the mycotoxins to chloroform. The method has been applied to corn, barley, oats, and wheat. The detection limits achieved are not as low as can be attained with the analytical procedures for the individual mycotoxins, but are low enough to be useful in a screening procedure. AS

50

Method for analysis and chemical confirmation of sterigmatocystin.

Stack, M.; Rodricks, J. V.

Journal of the Association of Official Analytical Chemists 54 (1) 86-90 (1971) [13 ref. En] [Div. of Food Chem. and Tech., FDA, Washington, DC 20204, USA]

A method is described for the analysis of grain samples for the presence and quantitative estimation of sterigmatocystin. Initial extraction with acetonitrile-water (9 + 1) containing KCl is followed by partition of the extract first against hexane and then against CHCl₃, and if needed, silica gel column chromatography. This sequence provides an extract in which the sterigmatocystin can be estimated by fluorescence intensity comparison on TLC plates against a pure sterigmatocystin standard. Visualization of the sterigmatocystin on the TLC plates is enhanced by an AlCl₃ spray reagent. After preparative TLC, the identity of sterigmatocystin is confirmed by formation of an acetate derivative and of a derivative formed by treating the suspected extract with aqueous acid. AS

51

[Mycotoxins as a food hygiene problem.] [A review] Korpinen, E.-L.
Suomen Eläinlääkärilehti 77 (4) 172-79 (1971) [27 ref. Fi, en]

Occurrence of mycotoxins in foods is reviewed, with particular reference to aflatoxin, ergotoin, the Fusarium toxins and the yellow rice toxins. Their significance as a general food hygiene problem is discussed. HBr

52

Aspergilli as ochratoxin producers.

Hesseltine, C. W.; Vandegrift, E. E.;

Fennell, D. I.; Smith, M. L.; Shotwell, O. L.

Bacteriological Proceedings 1971: 5 (1971) [En] [N. Regional Res. Lab., Peoria, Illinois, USA]

53

[Hygiene of liquid milk and milk products.]

Giolitti, G.

Scienza dell' Alimentazione 16 (7) 241-47 (1970) [It] [Istituto di Ispezione degli Alimenti di

Origine Animale, Univ., Milan, Italy]

This review-type article quotes numerous authors in the text, but no bibliography is appended. The subject is discussed under the headings: pathogenic schizomycetes and their toxins; presence of mycotoxins; presence of insecticide residues; presence of radioactive elements; presence of pharmaceutical product residues; presence of herbicide residues; and containers. HBr

54

The effect of pH on the thermal inactivation kinetics of patulin in McIlvaine's buffer.

Lovett, J.; Peeler, J. T.; Stenborg, E.

Bacteriological Proceedings 1971: 20 (1971) [En] [FDA, Cincinnati, Ohio, USA]

Patulin, 4 hydroxy-4H-furo [3,2c] pyran-2(6H)-one, is the carcinogenic metabolite of Aspergillus, Gymnoascus, and Penicillium species associated with foods. Patulin at concn. of 100-150 µg/ml in McIlvaine's buffer at pH 3.5, 4.5, and 5.5 was heated in sealed borosilicate tubes at 5°C intervals from 105 to 125°C. Ethyl acetate extraction and TLC were used for patulin assay. D values at 105, 110, 115, 120 and 125°C for pH 3.5 were: 1082.4, 742.4, 526.8, 378.2, and 268.4 min, respectively; for pH 4.5: 695.2, 444.6, 335.8, 235.7, and 167.2 min, respectively; and for pH 5.5: 166.4, 108.9, 70.9, 47.9, and 33.2 min, respectively. Z values for pH 3.5, 4.5, and 5.5 were 33.2 min, 33.0 and 28.5°C, respectively. The proportion of sums of squares (R²) due to linear regression for all sets of data was >0.99. Free energy of activation, enthalpy of activation, and entropy of activation computed on a per g mole basis, using 120°C (393.16°K) as the standard state, for pH 3.5 were: 31 100, 20 500, and -27.0 cal/g mole K, respectively; for pH 4.5: 30 700, 20 600, and -25.7 cal/g mole K, respectively; and for pH 5.5: 29 500, 24 100, and -13.7 cal/g mole K, respectively. Experimental energies of activation for pH 3.5, 4.5, and 5.5 were 20 800, 20 900, and 24 300 cal/g mole, respectively. AS

55

Tremortin production by Penicillium species on various agricultural commodities.

Hou, C. T.; Ciegler, A.; Hesseltine, C. W.

Bacteriological Proceedings 1971: 5 (1971) [En] [N. Regional Res. Lab., Peoria, Illinois, USA]

P. palitans produces 2 highly toxic tremorgens, tremortin A (C₃₇H₄₄O₆NCl) and B (C₃₇H₄₅O₅N). A quantitative chemical assay method was developed that is applicable for detection of tremortins in various agricultural commodities. Tremortin-producing moulds, isolated from commercial feedstuffs, grow well on high-moisture agricultural commodities at near freezing temp. Of 4 Penicillium species studied, P. palitans, P. cyclopium, P. puberulum, and P. crustosum, all show that lower temp. (4°C) favours accumulation of tremortins although rate of toxin formation is more rapid at 20°C. Commodities with high-protein content like soybeans and peanuts supported growth but no toxin synthesis. The extent of toxin production varied with the strain of mould, commodity, and temp. AS

56

T-2 toxin production by Fusarium tricinctum on

solid substrate.

Burmeister, H. R.

Applied Microbiology 21 (4) 739-742 (1971) [9 ref. En] [N. Regional Res. Lab., USDA, Peoria, Illinois 61604, USA]

A method has been developed to produce and purify gram quantities of T-2 toxin [4 β ,15-diacetoxy-8 α -(3-methylbutyryloxy)-12,13-epoxytrichothec-9-en-3 α -ol], a mycotoxin elaborated by a strain of *F. tricinatum* isolated from toxic corn. After growing for 3 wk at 15°C on 1200 g of white corn grits, *F. tricinatum* NRRL 3299 elaborated at least 9.0 g of T-2 toxin, and 2.3 g of crystalline product was recovered. A lesser amount of toxin was produced on rice, but none was detected in wheat incubated at 20°C. The amount of toxin measured in white corn grits declined as the incubation temp. was raised to 20, 25, and 32°C. AS

57

Biochemical and functional changes in stored cereal grains. [A review]

Pomeranz, Y.

CRC Critical Reviews in Food Technology 2 (1) 45-80 (1971) [63 ref. En] [Nat. Barley & Malt Lab., USDA, Madison, Wisconsin, USA]

After a description of kernel structure, dormancy, and germination of grains, recent investigations on the desirable changes in functional properties of grains stored under normal conditions, biochemical and functional changes in cereals stored under adverse conditions and attacked by moulds, and on toxins produced by fungi in storage-damaged cereals, are reviewed. PEG

58

[The mycotoxins. A present day problem.]

Jemmali, M.

Meunerie Francaise 274: 9-14 (1971) [15 ref. Fr] [Lab. de mycotoxines, Sta. de Biochimie et Physicochimie des Cereales, INRA, 16 rue Nicolas-Fortin. Paris-13e, France]

Conditions suitable for development of moulds, and in particular of *Aspergillus flavus*, on cereals for production of toxins are discussed with reference to temp., RH, composition of the substrate and treatment of the product. A survey is given of: the occurrence of mouldy feed toxicosis, *Stachybotrys toxicosis*, alimentary toxic aleukia and mouldy corn toxicosis; toxin-producing mould species; suitable substrates; hosts; and symptoms of the diseases. MDB

59

[*Aspergillus flavus*, an important mycotoxin producer.] *Aspergillus flavus*, ein bedeutender Mykotoxinproduzent. [A review]

Buntenkötter, S.

Deutsche Tierärztliche Wochenschrift 78 (10) 309-313 (1971) [87 ref. De] [Tierärztliche Hochschule, Hanover, W. Germany]

60

Factors affecting the production of mycotoxins. [A lecture]

Jarvis, B.

Journal of Applied Bacteriology 34 (1) 199-213 (1971) [81 ref. En] [Nat. Coll. of Food Tech., St. George's Ave., Weybridge, Surrey, UK]

Although the physical, chemical and biological factors influencing the ecology of mycotoxicosis

outbreaks can be evaluated in general terms, specific ecological factors affecting toxin production are often unknown. Studies with lab. media have shown that optimum toxin production often occurs at suboptimal growth temp., and even at sub-zero temp. in some cases. Toxin production is generally successful in laboratory studies using natural substrates. Many fungi grow well on chemically-defined media but require supplements such as yeast extract, malt extract or peptone for optimal toxin production. The ability of a particular species to produce toxin shows considerable strain variation. There is evidence for both synergism and antagonism between species of mycotoxic fungi when they are cultured together. The significance of mycotoxic fungi to man, and the validity of contemporary toxicity tests in relation to human responses are discussed. BAL

61

[Metabolic products of fungi in fruit juices and concentrates.] Stoffwechselprodukte der Schimmelpilze in Fruchtsäften und -konzentraten. [A review]

Eschmann, K. H.

Archiv für Lebensmittelhygiene 22 (6) 126-129 (1971) [50 ref. De] [Microbiol. Lab., Bactotox AG, CH 8172 Niederglatt, Switzerland]

The subject is reviewed with particular reference to effects of temp. and moisture on fungal growth, nutritional requirements of fungi, fungal spp. found in fruit juices, metabolic products (aflatoxins), and toxicity of mycotoxins. HBr

62

Occurrence of a mycotoxin, ochratoxin A, in wheat and isolation of ochratoxin A and citrinin producing strains of *Penicillium viridicatum*.

Scott, P. M.; Walbeek, W. van; Harwig, J.; Fennell, D. I.

Canadian Journal of Plant Science 50 (5) 583-585 (1970) [10 ref. En] [Res. Lab., Food and Drug Directorate, Ottawa, Ontario, Canada]

63

Environmental factors [moisture content, incubation temperature] affecting the synthesis of toxins by species of *Fusaria* [isolated from cereals].

Sherwood, R.; Peberdy, J. F.

Progress Reports on Research and Development, Home-

Grown Cereals Authority 1970/71: 40-42 (1970/71) [En] [Dept. of Botany, Univ. Nottingham UK]

64

[Toxin-forming *Micromyces*.]

Bilai, V. I.; Pidoplichko, N. M.

Izvestiya Akademii Nauk SSSR, Seriya Biologicheskaya 1970 (4) 600-608 (1970) [Ru, en] [Inst. Mikrobiol. i Virusologii AN USSR, Kijev, USSR]

A brief literature survey is given on toxin-forming *Micromyces* which decompose agricultural products, especially during harvest and storage, and can cause alimentary mycotoxicoses in humans and farm animals. Findings on the biological properties of toxins in various fungi are presented. STI

65

Grain Quality Research Committee. Summary of a

report on the activities of the Committee.
Trolle, B.; Pedersen, H. (Denmark, Academy of
Technical Sciences)
Journal of the Institute of Brewing 77 (4) 338-348
(1971) [En]

The results of collaborative research carried out in Denmark since 1963 have shown that the microflora of the stored material is of paramount importance in relation to grain quality, whether the grain is to be used for malting or for fodder. The composition of the fungal flora depends on the moisture activity of the stored product: whole barley at a moisture content of 14% has a moisture activity which just permits the survival of the fungi characteristic of sound newly-harvested grain. Feeding qualities are impaired when barley is stored at >17% moisture, with associated analytical changes in protein digestibility and in biological value of the protein; gushing in beer is on occasion associated with the presence of *Fusarium* in the stored barley. Although aflatoxin seems to be of no practical importance in Danish conditions, the mycotoxin citrinin (from *Penicillium viridicatum*) may be significant in fodder grain which has been allowed to deteriorate in damp storage. AS

66

[Microbiological aspects of Preservation.]

Jemali, M.
*Bulletin des Anciens Eleves de l'Ecole
Francaise de Meunerie* 241: 14-23 (1971) [13 ref.
Fr] [Sta. de Biochimie et Physico-chimie des
cereales, INRA, 16, rue Nicolas-Fortin, Paris 13e,
France]

Principal environmental factors causing changes in grain during storage are briefly discussed, namely RH, temp., O₂ and CO₂ content of atmosphere and time of storage and these factors are discussed in relation to the occurrence of oxidation, Maillard reaction, enzyme reaction and microbial growth. Microbial development and mycotoxin formation in free and controlled atmospheres are discussed with particular reference to the effect of RH. Other topics covered are: criteria for estimating the condition of grain and its suitability for grain storage; and methods of storage (e.g. storage; determination of suitable conditions for drying, refrigeration, controlled atmosphere). MDB

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67

[Mycotoxicosis resulting from contamination of wheat, bread and pastry with moulds.]

Stefanovic, M.
Hrana i Ishrana 12 (1/2) 37-40 (1971) [7 ref. Sh,
en] [Zavod za zdravstvenu zastitu SRS, Belgrade,
Yugoslavia]

This brief review covers common fungal contaminants of cereals and cereal products (e.g. *Penicillium*, *Aspergillus*); pathogenic and allergic effects of fungi in man; mycotoxicosis and carcinogenic effects of aflatoxin from mouldy cereals and bread; and control of fungi in cereals and bakery products. IN

68

Sensitivity of chicks to ochratoxins.

Chu, F. S.; Chang, C. C.
*Journal of the Association of Official Analytical
Chemists* 54 (5) 1032-1034 (1971) [15 ref. En]

[Food Res. Inst., Univ., Madison, Wisconsin 53706,
USA]

The acute toxicity of ochratoxin A and its derivatives in day-old chicks has been studied. The LD₅₀ was 166 and 216 µg/assay for ochratoxins A and C, respectively. No toxic effect was demonstrated when chicks were fed with up to 500 µg/chick of the hydrolysed product, i.e., dihydroisocoumarin. Based on results reported, the day-old chick assay is valid as a confirmatory test for ochratoxin. AS

69

Gas-liquid chromatography of mycotoxins of the trichothecene group.

Ikediobi, C. O.; Hsu, I. C.; Bamburg, J. R.; Strong, F. M.
Analytical Biochemistry 43 (2) 327-340 (1971) [13
ref. En] [Dept. of Biochem., Coll. of Agric. and
Life Sci., Univ., Madison, Wisconsin 53706, USA]

A gas chromatography method for separation and identification of several trichothecenes is described. Compounds containing free hydroxyl groups were chromatographed as trimethylsilyl (TMS) ethers, while naturally occurring esters such as trichothecin were chromatographed directly. Qualitative identification of individual peaks was provided by determining the methylene unit values of each of 13 different trichothecenes by both isothermal and temp.-programmed operation. Use of glucose TMS ether as an internal standard provided relative response factors useful in the quantitative determination of trichothecenes. The method was successfully applied to known mixtures of pure compounds and to determination of T-2 and HT-2 toxins in grain samples infected with *Fusarium tricinatum*. AS

70

Quantitative determination of tremortins in agricultural commodities.

Hou, C. T.; Ciegler, A.; Hesseltine, C. W.
*Journal of the Association of Official Analytical
Chemists* 54 (5) 1035-1036 (1971) [5 ref. En] [N.
Regional Res. Lab., Agric. Res. Service, USDA,
Peoria, Illinois 61604, USA]

The procedure described for the quantitative determination of tremortins in agricultural commodities involves extracting the agricultural commodity with chloroform-methanol (2 + 1), followed by TLC and colorimetric assay. This procedure was successfully applied to the analysis of tremortin A added to grains (corn, rice, wheat, rye, barley, sorghum, oats) and the production of tremortins A and B on grains. AS

71

Survey of corn from different regions for aflatoxin, ochratoxin and zearalenone.

Shotwell, O. L.; Hesseltine, C. W.; Vandegraft, E. E.; Goulden, M. L.
Cereal Science Today 16 (9) 266-270 & 273 (1971)
[23 ref. En] [N. Regional Res. Lab., Peoria,
Illinois 61604, USA]

The assay of 293 corn samples including all grades of export cargo corn from 10 ports, for aflatoxin, zearalenone and ochratoxin, is reported. 8 contained <6 to 25 parts/billion aflatoxin B₁ and 1 of these contained C₁ as well as B₁. One sample was in SG, 3 were in grade US No. 4, 3 in US No. 3 and 1 in US No. 2.

Aspergillus flavus was isolated from 7 of the 8 samples and *Asp. parasiticus* was isolated from the remaining positive sample. 3 samples contained ochratoxin A (83-166 parts/billion), 2 in grade US No. 4, and 1 in US No. 3. Zearalenone (450-750 parts/billion) was present in 5 samples - 1 in SG, 1 in US No. 4, and 3 in US No. 3. [See also FSTA (1971) 3 7M802.] AS

72

[Toxigenic fungi growing on stored rice.]

Miyaki, K.; Yamazaki, M.; Horie, Y.; Udagawa, S. *Journal of the Food Hygienic Society of Japan* [Shokuhin Eiseigaku Zasshi] 11 (5) 373-380 (1970) [11 ref. Ja, en] [Inst. of Food Microbiol., Chiba Univ., 3-9-1, Izumicho, Narashino-shi, Chiba-ken, Japan]

A survey of toxigenic moulds growing on rice stored for private consumption by farmers was made. 2 strains out of 59 of *Aspergillus ochraceus* were shown to produce ochratoxin A, and 18 strains out of 58 *A. versicolor* examined were found to produce sterigmatocystin. From the toxic *A. clavatus*, patulin was detected by TLC but no aflatoxin producing strain was found among the fungi belonging to the *A. flavus* and *A. oryzae* groups. The so called "yellow rice moulds" such as *Penicillium islandicum* and *P. citrinum* have been detected. TM

73

[Toxin-forming moulds in foods of plant origin.]

Toxinbildende Schimmelpilze in Lebensmitteln pflanzlicher Herkunft.
Müller, G.
Lebensmittel-Industrie 18 (8) 289-294 (1971) [9 ref. De, en, ru] [Sektion Nahrungsgüterwirtschaft und Lebensmitteltech., Humboldt-Univ., Berlin, Germany]

74

[Mycotoxins in foods. V. Formation of luteoskyrin in different foods.] Mykotoxine in Lebensmitteln. V. Bildung von Luteoskyrin in verschiedenen Lebensmitteln.

Rehm, H.-J.; Schmidt, I.
Zentralblatt für Bakteriologie, Parasitenkunde, Infektionskrankheiten und Hygiene, II. Abteilung 126 (4) 382-385 (1971) [6 ref. De, en] [Inst. für Mikrobiol., Univ., Münster, W. Germany]

A study was made of the growth of and luteoskyrin production by *Penicillium islandicum* in a variety of foods (butter, margarine, poppy seeds, hazelnuts, groundnuts, flaked coconut, wheat semolina, oat flakes, müsli for infants, apple and grape juices, wheat and rye bread and jam). Amounts of luteoskyrin were determined by chromatography after the organism had been allowed to grow on the foods for 3-4 wk (3 months in the case of butter and margarine). No growth or toxin was detected in butter, margarine or jam. Little growth and no toxin were found in müsli for infants, and good growth but only traces of toxin in poppy seeds and flaked coconut. Contents of toxin detected in other foods were (1 g food): hazelnuts 30 µg, groundnuts 15 µg, wheat semolina 26 µg, oat flakes 1 µg, apple juice 6 µg (1 g mycelium), grape juice 10 mg (1 g mycelium), wheat bread 1.3 mg, and rye bread 2.8 mg. HSi

75

The microorganisms in nuts and dried fruits.

Wehner, F. C.; Rabie, C. J.
Phytophactica 2 (3) 165-169 (1970) [11 ref. En, af, fr] [Res. Inst. for Plant Protection, Private Bag 134, Pretoria, R. of S. Africa]

By employing the agar plate method, the number and types of microorganisms on a variety of samples of processed and non-processed nuts and dried fruits was determined. Bacteria, fungi, yeasts and streptomycetes were found on these products, with counts varying from nil to 17 million per g. High microbial counts (>10 000/g) occurred only sporadically. Nuts contained the highest number of microorganisms, viticultural fruits second highest and tree fruits the lowest. Counts on non-processed samples were much higher than those on processed samples. Of the 13 taxa of bacteria, 28 taxa of fungi, 2 yeasts and streptomycetes that were encountered, *Bacillus* and *Aspergillus niger* V. Teighem spp. occurred most often. *Aspergillus flavus* Link, *A. niger*, *Monilia*, *Mucor*, *Penicillium frequentans* Westling, *P. notatum* Westling, *Rhizopus*, *Spicaria*, *Trichoderma* and an unidentified *Penicillium* sp. were tested for the production of toxins by incorporating maize, containing these fungi, into a chicken ration and feeding it to New Hampshire chickens. Rations containing *A. flavus*, *A. niger* and *Spicaria* caused detrimental effects. AS

76

Poultry mycotoxicosis as a source of mycotoxins in man's food chain.

Lovett, J.

Dissertation Abstracts International. Section B. The Sciences and Engineering 32 (5) 2781: Order no. 71-28317 (1971) [En] [Univ., Minneapolis, Minnesota 55414, USA]

The potential public health hazard associated with distribution and retention of patulin ingested by poultry was investigated. Screening of fungi in poultry feed and litter revealed 13 toxin producers. A toxic metabolite isolated from one of these (*Penicillium patulum*) was identified as patulin. ¹⁴C-patulin (¹⁴C-P) was fed to laying hens and chicks, and tissues and eggs assayed for retention of the labelled compound. Levels of ¹⁴C-P or its residue in eggs reflected the dosage ingested and declined rapidly when ingestion stopped; more ¹⁴C-P was found in egg yolk than white. ¹⁴C-P or its residue in blood was closely associated with the cellular elements which are involved in patulin inactivation. Following ingestion, ¹⁴C-P or its residue was present at low levels in most edible tissues and at higher levels in liver. Liver was the chief organ involved in detoxification and elimination, with ingested ¹⁴C-P eliminated in faeces within 48 h of cessation of ingestion. No biological activity was associated with ¹⁴C-P in any tissue examined. Whole blood and liver, kidney and intestine homogenates rapidly inactivated ¹⁴C-P in vitro. By-products of inactivation are not known. Based on the results of this study it is concluded that patulin ingestion by poultry has little public health significance. RM

77

Improved detection of ochratoxin A on thin layer plates.

Trenk, H. L.; Chu, F. S.

Journal of the Association of Official Analytical Chemists 54 (6) 1307-1309 (1971) [13 ref. En] [Food Res. Inst., Univ., Madison, Wisconsin 53706, USA]

The fluorescent spectra of ochratoxins A, B, and C, one of the hydrolysis products of ochratoxin A, i.e., 5-chloro-3,4-dihydro-8-hydroxy-3-methylisocoumarin-7-carboxylic acid, and their respective ammoniated derivatives have been studied. Excitation max. of these compounds shifted to a longer wavelength after exposure to NH_3 fumes, whereas the emission max. shifted to a shorter wavelength. The fluorescence intensity of ammoniated ochratoxin A was found to be almost twice that of ochratoxin A. It is suggested that TLC plates be exposed to NH_3 fumes prior to densitometric analysis to increase the sensitivity of the assay for ochratoxin A. AS

78

Byssochlamys fulva, metabolite toxicity in laboratory animals.

King, A. D., Jr.; Booth, A. N.; Stafford, A. E.; Waiss, A. C., Jr.

Journal of Food Science 37 (1) 86-89 (1972) [13 ref. En] [USDA, W. Regional Res. Lab., Berkeley, California 94710, USA]

The possible health hazard in man from the ingestion of canned food spoiled by the mould *B. fulva* was investigated. Rats were fed whole dried *B. fulva* culture medium at high dietary levels for 90 days and observed for abnormalities. The only adverse effects noted were a slower rate of growth, an increased liver wt. and a decrease in haemoglobin concn. Evidence was presented to suggest that the liver enlargement was due to microsomal stimulation. >90% of the ingested byssochlamic acid (a metabolite of this mould) was excreted in the faeces. The LD50 of sodium byssochlamate in mice by intraperitoneal injection was 94 mg/kg body wt., whereas the oral LD50 of byssochlamic acid was >2.5 g/kg. Byssochlamic acid was not produced in canned juices inoculated with *B. fulva*. IFT

79

[Mycotoxins - a problem in cereal chemistry and technology.] [A review]

Valtadoros, A.

Hemika Hronika 36 (10) 232-239 (1971) [93 ref. Gr, fr] [Cereal Inst., Thessaloniki, Greece]

Structure, properties and determination of aflatoxins B_1 , B_2 , G_1 and G_2 are reviewed. Methods of crop storage to prevent mycotoxin formation in Mediterranean countries and of detoxification proposed for tropical countries are indicated. RM

80

Acute intraperitoneal toxicity of ochratoxins A and B in rainbow trout. (*Salmo gairdneri*).Doster, R. C.; Sinnhuber, R. O.; Wales, J. H.
Food and Cosmetics Toxicology 10 (1) 85-92

(1972) [16 ref. En, fr, de] [Dept. of Food Sci. and Tech., Oregon St. Univ., Corvallis, 97331, USA]

The toxic effects of ochratoxins A and B, metabolites of *Aspergillus ochraceus*, and their dihydroisocoumarin derivatives ochratoxins a and b, were studied in 6-month-old Mt. Shasta strain rainbow trout. Ochratoxin A was the only compound found to be lethal to trout at the levels administered, its acute intraperitoneal LD50 being 4.67 mg/kg. Ochratoxins A and B produced pathological changes in the kidneys and liver, but ochratoxin a and b did not. It is suggested that ochratoxins A and B are metabolized to their non-toxic water-soluble dihydroisocoumarin moieties, which are readily excreted. VJG

81

Toxic chemicals in foods.

Falk, H. L.

Abstracts of Papers. American Chemical Society 163: AGFD18 (1972) [En] [Nat. Inst. of Environmental Health Sci., PO Box 12233, Res. Triangle Park, N. Carolina 27709, USA]

Toxic chemicals covered in this review include: toxic compounds occurring naturally in foods, mycotoxins, bacterial toxins, pesticides and other trace contaminants, and food additives. The risk of cancer from high-calorie diets and the possibility of synergism between different types of toxic food components are discussed. JA

82

Dietary aflatoxins and human liver cancer. I. Toxicogenic moulds in foods and foodstuffs of tropical South-East Asia.

Shank, R. C.; Wogan, G. N.; Gibson, J. B.

Food and Cosmetics Toxicology 10 (1) 51-60 (1972) [16 ref. En, fr, de] [Dept. of Nutr. and Food Sci., Massachusetts Inst. of Tech., Cambridge, 02139, USA]

Mycological studies were carried out on 3057 samples representing more than 170 different types of food, collected from towns and villages of Thailand and from Hong Kong, between Sept. 1967 and July 1969, in an attempt to evaluate the relationship between dietary loads of aflatoxin and incidence of liver cancer. Number of samples examined, number contaminated and individual moulds identified are tabulated for rice, peanuts, mung beans, corn, sesame seeds, cassava starch, dried fish/shrimp, fresh vegetables, spices, prepared foods etc. *Aspergillus* was found to be the commonest contaminating fungus with *Asp. flavus* the predominating species, but *Rhizopus*, *Penicillium* and *Fusarium* were also present. Seasonal variation in mould contamination in Thailand was also studied. Bioassays evaluating acute and subacute toxicity to rats identified the infecting agents capable of producing mycotoxins other than aflatoxins. Among 162 isolates, 49 proved to be toxigenic and these included species of all the genera commonly identified in food samples. VJG

83

[Occurrence and importance of foreign substances in cereals.] Vorkommen und Bedeutung von

Fremdstoffen bei der Getreidenahrung. [A review] Engst, R.

Ernährungsforschung 15 (2) 275-285 (1971) [29 ref. De]

The occurrence in cereals of pesticides and fumigants (e.g. DDT, lindane, pyrethrum + piperonyl butoxide, methoxychlor, malathion, parathion, dichlorvos, PH_3 , HCN, ethylene oxide, methyl bromide), plant growth regulators (e.g. chlorocholine chloride), nitrosamines, 3,4-benzopyrene, Pb, mycotoxins (particularly aflatoxin) is reviewed with reference to the source of such contaminants, residue levels in cereals, toxicity to humans, and tolerance levels in cereals. AFa

84

A gas chromatographic method for the mycotoxin penicillic acid.

Pero, R. W.; Harvan, D.; Owens, R. G.; Snow, J. P. **Journal of Chromatography** 65 (3) 501-506 (1972) [8 ref. En] [Nat. Inst. of Environmental Health Sci., PO Box 12233, Research Triangle Park, N. Carolina 27709, USA]

Chloroform-methanol extracts of mouldy rice and corn were analysed for penicillic acid and patulin by GLC, using 3% of Dexsil 300, 3% of OV-17, or 3% of OV-25 liquid phase on Gas-ChromQ. Penicillic acid was resolved satisfactorily using 3% of OV-17 and 3% of Dexsil 300. Patulin was resolved from the other mouldy rice components only on 3% of OV-17, indicating the limited usefulness of both the 3% Dexsil 300 and 3% of OV-25 columns for the analysis of toxins in whole extracts of rice. Similar results were obtained with a chloroform-methanol extract of mouldy corn. The detection limit in the crude extracts was 1 µg of each per 100 µg of extract. However, in combination with TLC preparative analysis, very minute amounts of penicillic acid can be analysed in food products by appropriate manipulation of sample size. AB

85

[Mycotoxins in foods. II. Determination of patulin in spontaneously moulded bread and bakery products.]

Mycotoxine in Nahrungsmitteln. II. Nachweis von Patulin in spontan verschimmeltem Brot und Gebäck.

Reiss, J.

Naturwissenschaften 59 (1) 37 (1972) [5 ref. De] [Mikrobiol. Lab. der Grahamhaus Studt KG, Bad Kreuznach, W. Germany]

1 g bread (or bakery product) spontaneously moulded with a *Penicillium* sp. was extracted for 10 min with 5 ml ethyl acetate. After decanting, the solvent was evaporated, and the residue (in 1 ml chloroform) subjected to TLC against a patulin standard using ethanol:water (4:1, v/v). Of 9 wheat/rye bread samples, 11 toasting bread samples and 1 cake sample, 3, 1 and 1 samples, respectively, were found to contain patulin. Amounts varied between 0.1 and 0.3 µg/g. [See **ESTA** (1971) 3 10M1169 for part I.] JA

86

Tenuazonic acid, a toxin produced by *Alternaria*

***alternata*.**

Meronuck, R. A.; Steele, J. A.; Mirocha, C. J.; Christensen, C. M.

Applied Microbiology 23 (3) 613-617 (1972) [12 ref. En] [Dept. of Plant Pathol., Inst. of Agric., Univ. of Minnesota, St Paul, 55101, USA]

57 of 87 isolates of *Alternaria alternata* (Fr) Keissler grown on autoclaved, moist corn-rice substrate and fed to rats were lethal. The major toxin produced was isolated and characterized as tenuazonic acid. 20 of 23 toxigenic *Alternaria* isolates examined produced tenuazonic acid. No tenuazonic acid could be detected in either of the field samples of sorghum or black-eyed peas, which were heavily invaded by *Alternaria*. AS

87

Occurrence of patulin in apple juice.

Scott, P. M.; Miles, W. F.; Toft, P. Dube, J. G. **Journal of Agricultural and Food Chemistry** 20 (2) 450-451 (1972) [11 ref. En] [Res. Lab., Food & Drug Directorate, Ottawa, Ontario, Canada]

The natural occurrence of patulin in a commercial sample of apple juice was demonstrated for the first time. The concn. was 1 ppm. Identification was by TLC, gas chromatography and MS on successively more purified material. AS

88

Preparation of lot samples of nut meats for mycotoxin assay.

Stoloff, L.; Dantzman, J.; Wegener, J.

Journal of the American Oil Chemists' Society 49 (4) 264-266 (1972) [5 ref. En] [Bureau of Food, FDA, Washington, DC 20204, USA]

A procedure has been devised for preparing lot samples of mycotoxin-contained nut meats so that a representative analytical sample may be removed. The sample is rapidly reduced to coarse size. A relatively large portion (~1/10 of total sample) of subsample is then split out and further comminuted to a fine particle size with the aid of a fat solvent (meat-solvent, w/v, 3:2). The analytical sample is removed from this mixture. The procedure was rested with shelled almonds and shelled walnuts using radioactive nuts to simulate mycotoxin contamination and provide a simple, precise measure of contaminated nut meat distribution. The pooled coeff. of variation was 18% for subsamples and 4.4% for analytical samples. Considering the dilution factors used (1.50 and 2.14 contaminated nuts/10⁴ nuts) and the low degree of reliability of the lot sample, the sample preparation methods tested appear to be practical and reliable. AS

89

[Toxigenic fungi contaminating home-made miso and soy sauce.]

Yamazaki, M.; Yoshikazu, H.; Fujimoto, H.; Suzuki, S.; Sakakibara, Y.; Miyaki, K.

Journal of the Food Hygienic Society of Japan [Shokuhin Eiseigaku Zasshi] 11 (5) 381-383 (1970) [11 ref. Ja, en] [Dept. of Mycological Sci., Inst. of Food Microbiol., Chiba Univ., Japan]

46 samples of miso and 11 of soy sauce collected in Tohoku district were examined. Mouse and chick embryo bioassays of isolated strains revealed 1 strongly toxic strain of *Aspergillus ochraceus* from soy sauce and 2 strongly toxic strains of *Penicillium cyclopium* from miso. [From En Summ.] CDA

90

Mould spoilage of foods.

Jarvis, B.

Process Biochemistry 7 (5) 11-14 (1972) [46 ref. En] [BFMIRA, Randalls Road, Leatherhead, Surrey, UK]

This general review covers factors affecting growth of moulds and the mould spoilage of raw food materials, processed and preserved foods and frozen foods, health hazards due to mycotoxin production, and standards for contamination of retail foods. SAC

91

Production of ochratoxins in different cereal products by *Aspergillus ochraceus*.

Trenk, H. L.; Butz, M. E.; Chu, F. S.

Applied Microbiology 21 (6) 1032-1035 (1971) [16 ref. En] [Dept. of Food Sci., Univ. of Wisconsin, Madison, 53706, USA]

Effects of temp. and length of incubation on ochratoxin A production in various substrates were studied. The optimal temp. for toxin production by *Aspergillus ochraceus* NRRL-3174 was found to be around 28°C. Very low levels of ochratoxin A are produced in corn, rice, and wheat bran at 4°C. The optimal time for ochratoxin A production depends on the substrate, ranging from 7 to 14 days at 28°C. Ochratoxin B and dihydroisocoumaric acid, i.e., one of the hydrolysis products of ochratoxin A, were produced in rice but at levels considerably lower than ochratoxin A. No ochratoxin C was produced in rice at 28°C. When added to rice cereal or oatmeal, the toxin was found to be very stable over prolonged storage and even to autoclaving for 3 h. AS

92

Chronic toxicity and carcinogenicity in mice of the purified mycotoxins, luteoskyrin and cyclochlorotene.

Uraguchi, K.; Saito, M.; Noguchi, Y.; Takahashi, K.; Enomoto, M.; Tatsuno, T.

Food and Cosmetics Toxicology 10 (2) 193-207 (1972) [42 ref. En, fr, de] [Dept. of Pharmacology, Fac. of Med., Univ. of Tokyo, Hongo, Japan]

Penicillium islandicum Sopp, an infectant of 'yellowed rice' produces 2 mycotoxins, luteoskyrin and a Cl-containing peptide, cyclochlorotene. Long-term feeding studies, initiated in 1960, have been carried out on the 2 mycotoxins. The results provide evidence that the 2 mycotoxins are responsible for the hepatotoxic and hepatocarcinogenic effects of yellowed rice. VJG

93

Bacterial penetration of eggs.

Vadehra, D. V.; Baker, R. C.

New York's Food and Life Sciences 5 (1) 9-11 (1972) [7 ref. En] [Dept. of Poultry Sci., St.

Agric. Expt. Sta., Ithaca, New York, USA]

Importance of the cuticle, which "clogs" the pores of the shell, in prevention of egg spoilage is noted. The shell allows passage of micro-organisms because of its porous nature, but the shell membranes, particularly the inner membrane, are a very effective barrier. Experiments have shown that penetration by bacteria is not caused by a digestive process. Electrical charge of the penetrating molecule has been shown to be critical; the more negative the charge on the molecule the faster the penetration. Chelating agents such as EDTA and penicillamine also increased permeability of the membranes. Some bacteria possess chelating agents which would benefit penetration. Current research involves determination of the growth mechanism of food poisoning bacteria and mycotoxic fungi in albumen, yolk and poultry meat. PG

94

[Identification of aflatoxins in mould cultures and foods.]

Puscariu, F.; Deac, C.; Gabor, M.

Igiene 20 (10) 587-596 (1971) [25 ref. Ro, fr, de, en, ru] [Inst. de Sanatate Publica si Cercetari Med., Cluj, Roumania]

Toxinogenic moulds were detected in Sibiu salami by identification of the aflatoxins by TLC and biological methods. *Aspergillus flavus* and other *Asp.* species were also identified in salami, cornflour and corn cobs. [From En summ.] HBr

95

[Presence of toxinogenic moulds in foods.]

Deac, C.; Puscariu, F.; Lörinczi, F.; Gabor, M.

Igiene 20 (6) 337-344 (1971) [23 ref. Ro, fr, de, en, ru] [Inst. de Sanatate Publica si Cercetari Med., Cluj, Roumania]

Moulds grown experimentally or developing spontaneously on salami, smoked sausage, dry beans, corn cobs and domestic preserves were examined. *Aspergillus* spp. were isolated from culture media and from food extracts (cornflour and peanuts) which produced substances similar to aflatoxin in fluorescence and toxicity. ELC

96

[A semi-quantitative method for determining patulin content of meat and meat products.] Eine halbquantitative Methode für die Bestimmung von Patulin in Fleisch und Fleischwaren.

Tauchmann, F.; Toth, L.; Leistner, L.

Fleischwirtschaft 51 (7) 1079-1080 (1971) [27 ref. De, en] [Bundesanstalt für Fleischforschung, Kulmbach, German Federal Republic]

A semi-quantitative chemical assay method for patulin produced by mould growth on meats is described, including extraction, purification by column chromatography, separation by TLC on kieselgel with toluene + acetone-chloroform (45:35:25), visualization by UV fluorescence and semi-quantitative determination by comparison with standard solutions. Limit of detection is ~0.5 ppm. 3 colour reactions confirming the identity of patulin were used: (i) 0.3% ammonia, then 4% phenylhydrazine; (ii) benzidine; (iii) anthrone reagent. RM

97

[Investigations on the inactivation of the mycotoxin patulin by sulphhydryl groups.] Untersuchungen über die Inaktivierung des Mykotoxins Patulin durch Sulfhydrylgruppen.

Hofmann, K.; Mintzlaff, H.-J.; Alperden, I.; Leistner, L.

Fleischwirtschaft 51 (10) 1534-1536 & 1538 (1971) [38 ref. De, en] [Bundesanstalt für Fleischforschung, Kulmbach, German Federal Republic]

The reaction of patulin with SH compounds was investigated in model experiments with reduced glutathione (G-SH) at pH 7.4, 6.0 and 5.0, using amperometric determination of unused SH groups and TLC-UV spectrophotometric determination of patulin. At pH 7.4 the reaction was rapid, 85% of the patulin disappearing after 1 h, 99% after 2 h and 100% after 3 h. At pH 6.0, 50% disappeared after 1 h, 95% after 4 h, and 100% after 7 days. At pH 5.0, 14% of the patulin was still present after 7 days. The patulin G-SH reaction product was not detectable by the normal chemical assay for patulin using diphenylboracic acid- β -amino ethyl ester and was not toxic by the chick embryo, rabbit skin and mouse tests. It was concluded that at the pH of meat and meat products most of the patulin produced by toxigenic moulds would be rapidly inactivated with the possible exception of dry sausages (Rohwurst) at low pH. RM

98

[Biological detection of mycotoxins in chickens with special reference to liver injuries.]

Mintzlaff, H.-J.; Christ, W.

Fleischwirtschaft 51 (12) 1802-1805 (1971) [26 ref. De, en] [Bundesanstalt für Fleischforschung, Kulmbach, German Federal Republic]

The organs, liver in particular, of chickens dosed with mycotoxins were examined to determine the lesion types that might develop. A hepatitis interstitialis lymphocytaria caused by several mycotoxins, but also inducible by other hepatotoxic substances, was observed histopathologically. The sensitivity of the chick to mycotoxins makes this bird suitable for detecting mycotoxin in foods, but more as a research tool for routine analysis. AS

99

[Moulds on soya presscake. Their dangers.]

Moreau, C.

Oleagineux 27 (6) 321-324 (1972) [11 ref. Fr, en, es] [Lab. de Biol. Vegetale, Univ. de Bretagne Occidentale, 29 N-Brest, France]

The mycological analysis of 4 samples of soya presscake revealed a large number of moulds. Pure presscake (50% protein) was relatively uncontaminated with a count of 50 000/g, presscakes with cellulose matter (44% protein) had counts of 179 000-400 000/g, which increased during storage. Several toxigenic species were identified, including *Aspergillus flavus*, *A. fumigatus*, *A. versicolor*, *A. ochraceus*, *A. niger*, *Fusarium roseum*, and *Absidia corymbifera*. Several species proliferated during storage, including *A. fumigatus* and *Abs. corymbifera*. RM

100

Isolation and identification of xanthotoxin (8-methoxypsoralen) and bergapten (5-methoxypsoralen) from celery infected with *Sclerotinia sclerotiorum*.

Wu, C. M.; Koehler, P. E.; Ayres, J. C.

Applied Microbiology 23 (5) 852-856 (1972) [12 ref. En] [Dept. of Food Sci., Univ. of Georgia, Athens, 30601, USA]

The skin-sensitizing phototoxins xanthotoxin (i) and bergapten (ii) have been reported in *Sclerotinia*-diseased celery and this study was carried out to investigate the environment necessary for the production of these furocoumarin toxins. A system for extracting these compounds and a TLC system suitable for their identification and quantitation were developed; hence the production of phototoxins on pink-rot celery was determined at various temp. The only conditions under which *Sclerotinia sclerotiorum* was capable of producing (i) and (ii) occurred when the mould was actively growing on fresh (metabolizing) celery. Neither compound was found in uninfected celery, in the mould growing on nutrient media, on nutrient media fortified with 30% filter-sterilized celery juice, or on nonmetabolizing celery. The ability of *S. sclerotiorum* to produce (i) and (ii) on several foods other than celery was determined. Although lettuce, cabbage, green beans and strawberries were easily infected and supported growth well, (i) and (ii) were not produced. Carrots, sweet potatoes, artichokes, oranges, cucumbers and turnips were less easily diseased, but even after allowing longer incubation to obtain sufficient mould growth neither (i) nor (ii) were detected. A significant infection of *S. sclerotiorum* could not be obtained on potatoes. These findings thus failed to demonstrate that *S. sclerotiorum* infection of food commodities other than fresh celery presented a phototoxicological hazard. AA

101

***Aspergilli* as ochratoxin producers.**

Hesseltine, C. W.; Vandegrift, E. E.; Fennell, D. I.; Smith, M. L.; Shotwell, O. L.

Mycologia 64 (3) 539-550 (1972) [29 ref. En] [N. Regional Res. Lab., USDA, Peoria, Illinois 61604, USA]

To determine whether ochratoxin is produced by species of *Aspergillus* other than *Asp. ochraceus*, 44 strains representative of the 9 spp. composing the *Asp. ochraceus* group were grown on both pearled wheat and cracked corn in duplicate shaken flasks at 28°C for 5 days. Rice was a poor substrate for ochratoxin production. Moulded substrates were extracted with acetonitrile-water; partially purified extracts were assayed for ochratoxins by TLC. All positive samples were confirmed by solubility in sodium bicarbonate and preparation of methyl esters. Ochratoxins A and B were found in some strains of *Asp. sulphureus*, *Asp. sclerotiorum*, *Asp. alliaceus*, *Asp. melleus*, *Asp. ochraceus*, *Asp. ostianus*, and *Asp. petrakii*. No ochratoxin was produced by the one strain of *Asp. elegans* or any of 6 strains of *Asp. auricomus*. 5 of 9 strains of *Asp. sclerotiorum* and 5 of 11 strains of *Asp. ochraceus* were negative. All 7 strains of *Asp.*

alliaceus were positive, but one was at a very low level. Generally, yields of ochratoxin were higher in wheat than in corn. Occasionally, as much ochratoxin B was produced as A. Highest yields of ochratoxins A and B were obtained from respective strains of *Asp. ochraceus* NRRL 3174 and NRRL 3519. Some strains of most species of the *Asp. ochraceus* group produce this mycotoxin as a secondary metabolite. AS

102

[Protective measures when working with mycotoxins.] Schutzmassnahmen beim Arbeiten mit Mykotoxinen.

Tauchmann, F.; Mintzlaff, H.-J.; Leistner, L. *Alimenta* 11 (3) 85-89 (1972) [10 ref. De, en] [Bundesanstalt für Fleischforschung, Kulmbach, German Federal Republic]

Requirements for safe handling, testing and detoxification of material contaminated with mycotoxins are described. Chief detoxification materials are 4% NaOCl, 6N HCl, 1% NaBO₂·H₂O₂·3H₂O, 1% NaHCO₃ and 5% formaldehyde. RM

103

[Hygiene of food and fodder in South America.]

[A review]

Mossel, D. A. A.

Scienza dell' Alimentazione 18 (5) 172-181 (1972) [53 ref. Fr, it, de, en] [Univ. San Marcos, Lima, Peru]

Certain components of compound feedstuffs, particularly fish and cottonseed flours originating from South America, have been shown to be carriers of salmonellae and mycotoxins. The sources of *Salmonella* contamination of fish flour manufactured in Peru and of Argentinian frozen beef and horse meat are discussed and methods for decontaminating foodstuffs are described. The prevention of mould growth, and thus of mycotoxin formation, is also discussed. MEG

104

[Study of foodstuffs contaminated by fungi.]

Dimitrov, M.

Khramitelna Promishlenost 20 (6/7) 24-26 (1971) [21 ref. Bg, ru, en, fr, de]

Experimental studies showed that *Fusarium sporotrichiella* is toxic to mice, guinea pigs, pigeons and rabbits. Mice and pigeons were shown to be suitable for laboratory studies of this organism. The toxicity of 55 cultures of *Fusarium sporotrichiella* was also studied using the skin test and by feeding to pigeons. No significant results were obtained in skin tests with rabbits. It was found that pigeons are very sensitive to *Fusarium sporotrichiella* toxin. STI

STI

105

Aflatoxins M₁ and M₂ and parasiticol: thin layer chromatography and physical and chemical properties.

Stubblefield, R. D.; Shotwell, O. L.; Shannon, G. M.

Journal of the Association of Official Analytical Chemists 55 (4) 762-767 (1972) [14 ref. En] [N. Regional Res. Lab., USDA, Peoria, Illinois 61604, USA]

106

Comparative rates of hydrolysis of ochratoxins A and B in vitro.

Doster, R. C.; Sinnhuber, R. O.

Food and Cosmetics Toxicology 10 (3) 389-394 (1972) [12 ref. En, fr, de] [Dept. of Food Sci. & Tech., Oregon St. Univ., Corvallis, 97331, USA]

The rates of hydrolysis of ochratoxins A and B [metabolites produced by the mould *Aspergillus ochraceus*] in vitro by the enzyme, bovine carboxypeptidase A, and by enzyme in tissue extracts of rat liver, small intestine and large intestine were studied. The V_{max} values for the hydrolysis of ochratoxins A and B by carboxypeptidase are 5.15 × 10⁻⁷ and 4.35 × 10⁻⁵ moles/l./min respectively. Incubation of the extracts of rat tissue with an equimolar amount of ochratoxin A or B indicated that ochratoxin B was hydrolysed 6-7 times faster than ochratoxin A. It is suggested that this difference in hydrolysis rate may partly account for the difference in toxicity of ochratoxins A and B. AS

107

Mycotoxins in feedstuffs and their effect on dairy cattle.

Lynch, G. P.

Journal of Dairy Science 55 (9) 1243-1255 (1972) [131 ref. En] [Animal Sci. Res. Div., USDA, Beltsville, Maryland 20705, USA]

Toxins produced by *Aspergillus*, *Fusarium* and *Penicillium* spp., and other fungal toxins reported in feedstuffs, are reviewed with particular reference to their possible effects on dairy cattle and other livestock and to residues of aflatoxins in tissues and milk of cattle and sheep. CDP

VOLUME 5

108

[Present state of mycotoxin research.]

Gegenwärtiger Stand der Mycotoxin-Forschung.

Meyer, H.; Leistner, L.

Fleischwirtschaft 50 (10) 1414-1415 (1970) [5 ref. De, en] [Bundesanstalt für Fleischforschung, Kulmbach, Federal Republic of Germany]

The progress of mycotoxin research since 1890 is briefly discussed. The 63 mycotoxins known are listed according to their degree of toxicity. At present about 240 toxigenic mould-species are known, of these 75 are listed. AS

109

The long-term toxicity of ochratoxin A to rats.

Purchase, I. F. H.; Watt, J. J. van der

Food and Cosmetics Toxicology 9 (5) 681-682 (1971) [5 ref. En] [Nat. Inst. for Nutr. Diseases, Med. Res. Council, Private Bag 380, Pretoria, South Africa]

Ochratoxin A prepared from cultures of *Aspergillus ochraceus* was used in subcutaneous and oral studies with rats. In subcutaneous studies, 1.25 mg ochratoxin A/ml sunflower seed oil (giving an ochratoxin dosage of 2.5 mg/kg) was twice weekly injected subcutaneously into rats. Oral studies involved feeding groups of 10 rats with ochratoxin A at the 100 and 300 µg level (dissolved in 0.5 ml sodium bicarbonate), 5

days/wk for 5 wk. In subcutaneous studies tumours occurred in both test and control groups; therefore it is reasonable to assume that the solvent (sunflower seed oil) was responsible for the tumours. The oral toxicity test also indicated that ochratoxin A is not carcinogenic in rats. VJG

110

Tracheal organ cultures for the bioassay of nanogram quantities of mycotoxins.

Cardeilhac, P. T.; Nair, K. P. C.; Colwell, W. M. *Journal of the Association of Official Analytical Chemists* 55 (5) 1120-1121 (1972) [3 ref. En] [Dept. of Vet. Sci., Univ. of Florida, Gainesville, 32601, USA]

See also FSTA (1970) 2 5C87.

111

Potential production and detoxification of penicillic acid in mold-fermented sausage (salami).

Ciegler, A.; Mintzlaff, H.-J.; Weisleder, D.; Leistner, L.

Applied Microbiology 24 (1) 114-119 (1972) [20 ref. En] [Inst. für Bakt. und Histologie, Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

About 10% of 346 *Penicillium* cultures isolated from mold-fermented sausage synthesized the toxic metabolite penicillic acid on liquid media. Five of these producing cultures inoculated onto sausage failed to produce this toxin in up to 70 days of ripening. Several amino acids normally occurring in meat (cysteine, glutathione, arginine, histidine, and lysine) were found capable of readily reacting with penicillic acid. The adducts formed by the reaction between cysteine or glutathione with penicillic acid were identified and found to be nontoxic to mice, quails, and in the rabbit skin test but exhibited toxicity to the chick embryo. Hypotheses accounting for this residual toxicity are advanced.

AS

112

[Biological determination of mycotoxins with the chick embryo test.] Biologischer Mykotoxin-Nachweis mit dem Hühnerembryotest.

Mintzlaff, H.-J.; Christ, W.

Fleischwirtschaft 52 (9) 1174-1176 (1972) [15 ref. De, en] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

Using a modified chick embryo test the toxic effect of the mycotoxins aflatoxin, tremortin, ochratoxin, citrinin, patulin, penicillic acid, genticic acid and kojic acid as well as of filtrates and extracts from several mould species (*Penicillium expansum*, *P. miczynskii*, *P. simplicissimum*, *P. cyclopium*, *P. viridicatum*, *P. janthinellum*, *P. palitans*, *P. citrinum* and *Scopulariopsis* sp.) isolated from meats was demonstrated. The chick embryo test is recommended as a biological assay for mycotoxins, because it is sensitive, simple and quite rapid. However, so far no specific reactions for mycotoxins have been observed in the chick embryo test. Perhaps the specificity of this assay could be improved by using a special stain for demonstrating teratotoxic effects. AS

113

Ochratoxin synthesis by *Penicillium* species.

Ciegler, A.; Fennell, D. J.; Mintzlaff, H.-J.; Leistner, L.

Naturwissenschaften 59 (8) 365-366 (1972) [7 ref. En] [N. Regional Res. Lab., Peoria, Illinois, USA]

Ochratoxin A is a toxic dihydroisocoumarin derivative produced primarily by members of the *Aspergillus* group, but also known to be synthesized by one species of *Penicillium*, *P. viridicatum*. During the course of a survey of the mycotoxin-producing potential of *Penicillia* isolated from mould-fermented sausage, 17 out of 422 cultures were found capable of ochratoxin A production. These isolates represented 3 and possibly 4 new species additional to *P. viridicatum*, that could synthesize this mycotoxin. Of the 17 isolates, 12 were identified as *P. viridicatum*, 2 as *P. variabile*, one as *P. commune*, one as *P. purpurescens* and one as possibly *P. cyclopium*.

AA

114

Spectroanalytical parameters of fungal metabolites.

II. Luminescence of griseofulvin.

Neely, W. C.; McDuffie, J. R.

Journal of the Association of Official Analytical Chemists 55 (6) 1300-1304 (1972) [25 ref. En] [Dept. of Chem., Auburn Univ., Alabama 36830, USA]

See FSTA (1973) 5 2C30 for part I.

115

Spectroanalytical parameters of fungal metabolites.

III. Ochratoxin A.

Neely, W. C.; West, A. D.

Journal of the Association of Official Analytical Chemists 55 (6) 1305-1309 (1972) [20 ref. En]

116

Fungal toxins.

Anon.

British Food Journal 75 (852) 18, 19, 21 (1973) [En]

The subject is discussed under the headings: *Penicillia*; *Fusaria*; *Aspergilli*; *Pithomyces*; other toxigenic fungi; Hazards to man. JN

117

Mycotoxins (ochratoxin A, citrinin, and sterigmatocystin) and toxigenic fungi in grains and other agricultural products.

Scott, P. M.; Walbeek, W. van; Kennedy, B.; Anyeti, D.

Journal of Agricultural and Food Chemistry 20 (6) 1103-1109 (1972) [44 ref. En] [Food Res. Lab., Health Protection Branch, Dept. of Nat. Health and Welfare, Ottawa, Ontario K1A 0L2, Canada]

Ochratoxin A was detected in 18 out of 29 samples of heated grain from Saskatchewan farms at concentrations of 0.03 to 27 ppm. After development of an appropriate screening method, 13 of these samples were also found to contain citrinin (0.07 to 80 ppm). Sterigmatocystin was detected in one grain sample. Strains of *Penicillium viridicatum* Westling or *P. palitans* Westling, producing either ochratoxin A or citrinin or

(usually) both toxins concomitantly, were isolated from 22 grain samples (including 16 of those containing ochratoxin A), from three samples of mixed feeds (one of which contained ochratoxin A), from four samples of dried white beans (three containing ochratoxin A), and from an ochratoxin A positive sample of moldy peanuts. *P. cyclopium* Westling that produced penicillic acid was isolated quite frequently, particularly from mixed feeds, although the mycotoxin itself was not found in the samples. Zearalenone was identified in a culture of *Fusarium equiseti* (Corda) Sacc. isolated from a wheat sample. AS

118

Carcinogens produced by fungi. [Review]

Enomoto, M.; Saito, M.

Annual Review of Microbiology 26, 279-312 (1972) [133 ref. En] [Dept. of Carcinogenesis & Cancer Susceptibility, Inst. of Med. Sci., Univ. of Tokyo, Japan]

In this review the problem of mycotoxin contamination of human foodstuffs is discussed. Detection of carcinogenic mycotoxins such as aflatoxins, sterigmatocystin, luteoskyrin, patulin, penicillic acid and griseofulvin is discussed. Field and storage surveys have revealed the actual existence of carcinogenic aflatoxins in staple foods and regular side dishes in such places as Uganda, Swaziland, the Transvaal of S. Africa, Japan, the Philippines, Thailand, the Inhambane area of Mozambique and New Guinea. Results of field investigations on isolation of toxic fungi from foods showed that most of the fungal species belonged to the 2 major genera of the storage fungi, *Aspergillus* and *Penicillium*. The foods included: rice grains (unhulled, rough and polished rice); other cereal grains (wheat, barley etc.); rice and wheat flour; soybeans; red beans and other legumes; fermented foods such as miso (soybean paste), shoyu (soy sauce), moromi (mash), tsukemono (Japanese pickles), and nukamiso (pickled vegetables in a mixture of rice bran, salt and water); dried fish; and edible seaweeds. Exploration of new carcinogenic mycotoxins is covered, including discussion of methods of screening carcinogens, cancer induction in humans by ingested mycotoxins and chronic toxicity and carcinogenic effect. AA

119

[Moulds in the baking industry. II.]

Ticha, J.

Mlynsko-Pekarensky Prumysl 18 (7) 220-221 (1972) [14 ref. Cs] [Vyzkumny Ustav Mlynsko-pekarenskeho Prumyslu, Prague, Czechoslovakia]

Various mycotoxins and the diseases caused by them are discussed. Their chemical structure is described and new methods by means of which individual mycotoxins are isolated from substrates and estimated qualitatively and quantitatively are covered. Substrates which are particularly favourable for ochratoxin formation are oats, rye and wheat bread. It is necessary to assess which types of mould found on cereals are potentially toxic. STI

120

Potential mycotoxin problems in mould-fermented sausage.

Mintzlaff, H.-J.; Ciegler, A.; Leistner, L.
Zeitschrift für Lebensmittel-Untersuchung und Forschung 150 (3) 133-137 (1972) [11 ref. En, de] [Bundesanstalt für Fleischforschung, Kulmbach, Federal Republic of Germany]

422 *Penicillium* cultures isolated from salamis produced in 11 European countries were assayed for their ability to produce mycotoxins. 88 isolates were found capable of toxin synthesis: 44 produced penicillic acid; 17 ochratoxin A; 11 tremortin A; 10 citrinin; 6 patulin; and 3 cultures produced both patulin and citrinin. Sausages were ripened with 6 moulds producing penicillic acid, 17 producing ochratoxin, 5 producing citrinin and 3 each producing patulin or tremortin. No mycotoxins were detected ≤ 70 days' ripening. Direct addition of penicillic acid to raw sausage resulted in disappearance of the mycotoxin. Amino acids normally occurring in meat were found capable of rapidly reacting with penicillic acid to product adducts that were nontoxic to laboratory animals. From the data obtained it was concluded that many *Penicillium* species with toxigenic capacity can be found on mould-fermented sausage but, that in these experiments, toxin production was not detected on the meat. However, the potential for toxin synthesis exists and it is recommended that manufacturers adopt pure culture techniques using moulds known to be toxicologically safe. AA

121

[Hygienic significance of fungi in foods.]

Jantea, F.; Oprisescu, D.; Stancescu, B.; Molnar, A.; Sepeteanu, A.

Igiena 21 (8) 495-504 (1972) [17 ref. Ro] [Catedra de Igiena Alimentatiei, I. M. F., Bucharest, Rumania]

The dangers of fungi are reviewed, including a systematic table of the various toxic effects of many fungi. 109 samples of cheeses taken at the point of sale were examined by incubation at 22-24°C for 3-5 days. Pickled Telemea cheese (25 samples) contained 45 fungi/g; Burduf-type cheese, a kneaded, soft curd cheese (10 samples), 1370/g; Kachkaval cheese (29), 408/g; semi-hard cheese (30), 826/g; Svaiter cheese, a hard cheese (7), 334/g; and processed cheese (8), 650/g. Most of the fungi isolated from the interior of the cheeses were *Penicillium* or *Aspergillus* spp. Cheese is considered to be the most dangerous of the animal foods as far as fungal toxins are concerned. JMD

122

[Contaminants of fungal origin in foods.]

Nicolet, J.

Euroviande - Courrier des Abattoirs 14 (75) 23-27 (1973) [6 ref. Fr] [Ecole Veterinaire, 3000 Berne, Switzerland]

Particular reference is made to mycotoxins, and a description is given of their chemical structure, mode of action and toxicity. Detection and prevention of their presence in foods are also covered. HBr

123

Sterigmatocystin in coffee beans.

Purchase, I. F. H.; Pretorius, M. E.

Journal of the Association of Official Analytical Chemists **56** (1) 225-226 (1973) [9 ref. En]

[Div. of Toxicology, Nat. Res. Inst. for Nutr. Diseases, Med. Res. Council, Private Bag X380, Pretoria, S. Africa]

Sterigmatocystin, a toxic fungal metabolite, was found in one of 2 samples of green coffee beans which had been condemned as unfit for human consumption. The analysis, which was carried out according to a modification of the AOAC official first action method for aflatoxin in coffee beans, showed 1143 parts/billion sterigmatocystin to be present in the sample. In addition, 3 confirmatory tests showed the presence of the compound. Screening coffee beans for sterigmatocystin is suggested as a routine practice. AS

124

Natural toxins in food and feeds. [Symposium]

Buck, W. B.; Oehme, F. W. (USA, American College of Veterinary Toxicologists Bergdoll, M. S.; Goldblatt, L. A.; Stoloff, L.) (Editors)

Clinical Toxicology **5** (4) 437-580 (1972) [many ref. En]

In July 1971, in conjunction with the 108th Annual Convention of the American Veterinary Medical Association, the American College of Veterinary Toxicologists sponsored a scientific session with a symposium on natural toxins in food and feeds. Papers presented at the symposium are given and include: The nature of bacterial toxins, by M. S. Bergdoll (pp. 441-451, 37 ref.); Implications of mycotoxins, by L. A. Goldblatt (pp. 453-464, 28 ref.); and Analytical methods for mycotoxins, by L. Stoloff (pp. 465-494, 137 ref.). JA

125

A rapid procedure for the isolation, identification and estimation of citrinin.

Damodaran, C.; Ramadoss, C. S.;

Shanmugasundaram, E. R. B.

Analytical Biochemistry **52** (2) 482-488 (1973)

[14 ref. En] [Univ. Biochem. Lab., AC Coll. Campus, Madras-25, India]

A rapid procedure for the isolation, identification, and estimation of citrinin, the antibiotic cum nephrotoxin, has been proposed. The colorimetric procedure proposed for estimation makes use of the phenolic function of the compound. This method was found to be applicable to a wide variety of material [including fungal-contaminated food materials e.g. rice and wheat]. AS

126

[Summaries of papers presented at the Karlsruhe Mycotoxin Symposium held on September 28th 1972.] Zusammenfassende Übersichtsberichte des Karlsruher Mykotoxin Symposiums am 28. September 1972.

Anon.

Zeitschrift für Lebensmittel-Untersuchung und

-Forschung **151** (4) 225-273 (1973) [many ref. De, en]

Papers include: Introduction to the mycotoxin problem, by H. K. Frank (pp. 225-230, 32 ref.); Mycotoxins in feed, by J. M. Möller (pp. 231-236, 24 ref.), which contains a section on mycotoxins in foods of animal origin; Mycotoxins in milk and milk products, by F. Kiermeier (pp. 237-240, 12 ref.); Mycotoxins in meat, by L. Leistner & H.-J. Mintzlaff (pp. 241-244, 21 ref.); Effect of aflatoxins in man and animals, by H. Bösenberg (pp. 245-249, 10 ref.); Biosynthesis of mycotoxins, by H. J. Rehm (pp. 260-266, 34 ref.); and Conditions for production of some carcinogenic mycotoxins, by R. Orth (pp. 267-273, 30 ref.). JA

127

[Analytical problems in the detection of mycotoxins.] Analytische Probleme beim Nachweis von Mykotoxinen.

Bösenberg, H.

Getreide, Mehl und Brot **27** (3) 94-97 (1973)

[De]

Methods of recognising mycotoxins if present in foods and of distinguishing them from associated non-toxic substances of somewhat similar properties are discussed. For routine examination, chemical and physical methods, preferably take precedence over the more sensitive but time-consuming biological methods. Use of a recommended combination, TLC and UV spectroscopy is facilitated by employing a chromatogram-spectrophotometer which conducts UV analysis directly on the fluorescing spots on the chromatogram. Absorption patterns in the 200-400 nm range and measurements at 362 nm are compared with those furnished by external and internal standards. Examples are given illustrating the use of the method to confirm or exclude mycotoxin causation in food poisoning cases. GTP

128

[Mycotoxins from mouldy cereals.] [Review] Morooka, N.

Journal of the Food Hygienic Society of Japan[Shokuhin Eiseigaku Zasshi] **12** (6) 459-472

(1971) [72 ref. Ja] [Fac. of Agric., Kagawa Univ., Miki-cho, Kagawa-ken, Japan]

A review is given of research on mycotoxins produced by *Fusarium* sp. and of microbiological investigations of barley and wheat infected by *Fusarium* spp. in the Kagawa area in 1970. TM

129

[Investigations on formation of patulin in fermented sausages.] Untersuchungen über die Bildung des Mykotoxins Patulin in Rohwurst.

Alperden, I.; Mintzlaff, H.-J.; Tauchmann, F.; Leistner, L.

Fleischwirtschaft **53** (4) 566-568 (1973) [26 ref. De, en] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Federal Republic of Germany]

Penicillium expansum occurs frequently in meat and meat products. Some *P. expansum* strains produce patulin, a carcinogenic lactone. From 120

P. expansum strains isolated from meats, 17 (15%) produced patulin in potato dextrose broth (Difco) up to 230 ppm. Fermented sausages (salami) were inoculated with 3 strains of *P. expansum* and one of *P. urticae*, which produced patulin in potato dextrose broth. These moulds did grow well on the product. However, patulin was detectable during ripening or storage of the fermented sausages only in sausages inoculated with *P. expansum* SM and 597, on the 10th-18th day of ripening. After 24 days' storage at 25°C and high RH, sausages were mouldy and inedible but contained no patulin. Absence of patulin was attributed to its reaction with SH-compounds (glutathione, cysteine) at the high pH of spoiled sausages (7.1-7.9). RM

130

Current efforts of the Food and Drug Administration to control mycotoxins in food.

Fischbach, H.; Rodricks, J. V.

Journal of the Association of Official Analytical Chemists **56** (3) 767-770 (1973) [14 ref. En] [Bureau of Foods, FDA, Washington, DC 20204, USA]

This general report outlines work in progress in the USA. Following development of a reliable, sensitive and specific methodology for mycotoxins, leading, for example, to determination of aflatoxin in peanuts and general methods for determination of concn. and purity of aflatoxin, it has been demonstrated that mycotoxins are highly significant potential food contaminants which may have serious health effects, probably of a chronic nature. Analytical and control operations, by both official bodies and industrial users, are essential; for this purpose a new minicolumn qualitative method for aflatoxin should be valuable for district and industrial use. In addition, more work is needed on methods of preventing mould proliferation in foods. At present, definite contamination potential has been established for peanuts, cottonseed, copra, corn, and various tree nuts; moreover, aflatoxin can be transmitted from these materials (used in animal feeds) to milk, eggs and meat. Preliminary results show that transmission to milk occurs with 33 µg aflatoxin/kg animal feed. Research is also in progress on chemical and toxicological characteristics of other mycotoxins (particularly ochratoxins and sterigmatocystin) and their incidence, conditions of occurrence, possible transmission to animal foods and the effects of processing. ELC

131

Mycotoxins.

Pitt, J. I.

Food Technology in Australia **25** (6) 291-294 (1973) [4 ref. En] [CSIRO Div. of Food Res., North Ryde, NSW 2113]

The occurrence of mycotoxins in mouldy foods is briefly discussed, with reference to ergot, alimentary toxic aleukia, aflatoxins, mouldy rice toxins (islanditoxin and luteosykrin) and other mycotoxins (citreoviridin, citrinin, patulin, ochratoxin A and sterigmatocystin). AJDW

132

Improved method for the thin layer chromatographic determination of patulin in apple juice.

Scott, P. M.; Kennedy, B. P. C.

Journal of the Association of Official Analytical Chemists **56** (4) 813-816 (1973) [24 ref. En] [Health Protection Branch, Dept. of Nat. Health and Welfare, Ottawa, Ontario, Canada K1A 0L2]

Apple juice from a freshly opened container is extracted 3 times with ethyl acetate. The extract is dried, concentrated, diluted with benzene, and added to a silica gel column. Patulin is eluted by benzene-ethyl acetate (75 + 25) and detected by TLC, using a 3-methyl-2-benzothiazolinone hydrazone hydrochloride solution as the spray reagent. Satisfactory recoveries were obtained for patulin added to apple juice at levels of 25-400 µg/l. AS

133

Micotoxin production affected by insecticide treatment of wheat.

Vandegraft, E. E.; Shotwell, O. L.; Smith, M. L.; Hesseltine, C. W.

Cereal Chemistry **50** (3) 264-270 (1973) [19 ref. En] [N. Regional Res. Lab., Peoria, Illinois 61604, USA]

Insecticide treatment of wheat both increased and decreased aflatoxin and ochratoxin production depending on the fungal strains used (*Aspergillus flavus*, *Asp. parasiticus*, *Asp. ochraceus*, and *Penicillium viridicatum*). Some strains were affected the same by phosphine and carbon tetrachloride:carbon disulphide treatment while others were affected oppositely. In some experiments the effect of insecticide treatment was significant on wheat sterilized by autoclaving at about 25% moisture but not on unsterilized. Mycotoxin production by most moulds is enhanced on wheat sterilized by autoclaving before inoculation. AS

134

[Formation of sterigmatocystin by *Aspergillus versicolor* in microbiological media and in fermented sausages.] Bildung von Sterigmatocystin in mikrobiologischen Nährmedien und in Rohwurst durch *Aspergillus versicolor*.

Alperden, I.; Mintzlaff, H.-J.; Tauchmann, F.; Leistner, L.

Fleischwirtschaft **53** (5) 707-710 (1973) [27 ref. De, en] [Bundesanstalt für Fleischforschung, 8650 Kulmbach, Blaich 4, Federal Republic of Germany]

Aspergillus versicolor occurs quite frequently on meats with a low a_w . Of 15 *A. versicolor* strains isolated from meats and spices 13 (87%) produced sterigmatocystin in microbiological media, the yield of one strain reaching 3350 ppm. In fermented sausages (salami) inoculated with 2 toxigenic *A. versicolor* strains small quantities of sterigmatocystin were produced during the ripening phase only if unusually high ripening temp. were used (8 days at 24°C). The occurrence of sterigmatocystin is more likely during the storage of salami without refrigeration. In finished products

inoculated with 2 toxinogenic *A. versicolor* strains terigmatocystin was demonstrated already after 7 days storage at 25°C in the order of 1 to 2 ppm in the casing and of 0.1 ppm in the interior of the salami. AS

135

Analysis of ochratoxins A and B and their esters in barley, using partition and thin layer chromatography. I. Development of the method.

Nesheim, S.; Hardin, N. F.; Francis, O. J., Jr.; Langham, W. S.

Journal of the Association of Official Analytical Chemists **56** (4) 817-821 (1973) [14 ref. En] [Div. of Chem. and Physics, FDA, Washington, DC 20204, USA]

A convenient, specific, rapid method, developed for the determination of ochratoxin in barley, involves initial extraction of the sample with water-chloroform (1 + 9), followed by chromatography of the extract on an aqueous sodium bicarbonate-diatomaceous earth column. The ochratoxin esters are removed from the column with hexane-chloroform. Elution of the column with formic acid-chloroform (1 + 99) yields ochratoxins A and B. The ochratoxin esters are purified further on an aqueous sodium bicarbonate-methanol-diatomaceous earth column. The extracts are then quantitated on TLC plates by measuring fluorescence intensity. The presence of ochratoxins A and B is confirmed through formation of the corresponding ethyl ester derivatives. In an intralaboratory study, in which samples spiked at 25, 50, and 100 µg/kg levels were analysed by 4 analysts, the average recovery for ochratoxin A was 81.2% with a lower detection limit of 12 µg/kg. AS

136

Analysis of ochratoxins A and B and their esters in barley, using partition and thin layer chromatography. II. Collaborative study.

Nesheim, S.

Journal of the Association of Official Analytical Chemists **56** (4) 822-826 (1973) [4 ref. En]

To test the method of Nesheim et al. [see preceding abstr.], 6 samples were analysed in 13 laboratories. The samples encompassed a blank and 5 samples containing one or more ochratoxins in the range 50-200 µg/kg. Two samples were spiked with the 4 ochratoxin standards and 3 were spiked with barley naturally contaminated with ochratoxin A. The confirmation of identity of ochratoxins A and B by preparation of their ethyl ester derivatives was also tested. The average recovery of standard ochratoxin A was 112% at levels of 45 and 90 µg/kg, with a 27.1% coefficient of variation calculated from analysis of variance, one analyst, one replicate. Similar satisfactory results were obtained for the ethyl esters of A and B at a level of 120 µg/kg. The results were unsatisfactory for ochratoxin B and for the esters of A and B at the 60 µg/kg level. The chemical confirmation test was satisfactory for both ochratoxins A and B. The method, including chemical confirmation, has been adopted as official first action as quantitative for ochratoxin A and qualitative for the other toxins. AS

137

[Gas-liquid chromatographic assay of sterigmatocystin. II. Extraction and clean-up method for sterigmatocystin analysis of rice.]
Manabe, M.; Minamisawa, M.; Matsuura, S.
Journal of the Agricultural Chemical Society of Japan [Nihon Nogei Kagakkai-shi] **47** (3) 209-215 (1973) [14 ref. Ja, en]

Sterigmatocystin was extracted from ground rice by ethyl acetate and the ethyl acetate extract containing sterigmatocystin was evaporated to near dryness. The dry residue was dissolved in methanol-20% KCl solution (4:1 v/v) and lipids were removed by extraction with hexane. The 80% methanol solution was adjusted to a 50% methanol concn. with water. Sterigmatocystin was extracted from the methanol phase with chloroform and the chloroform extract was evaporated. The dry residue was then dissolved in acetone and added to a Sephadex LH-20 column (8 × 500 mm). Acetone was then added to the column and the eluate containing sterigmatocystin was collected and evaporated to near dryness. The dry residue was dissolved again in acetone and used for GLC. By this procedure, the min. detectable quantity of sterigmatocystin in rice was 0.05 ppm. AS

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